PMEL

NAVWEPS ~~AN~~ 16-45-125

Handbook

Operation and Maintenance Instructions

FM SIGNAL GENERATOR Type 202-B

(BOONTON RADIO)

THIS PUBLICATION SUPERSEDES AN 16-45-125
DATED 1 OCTOBER 1950

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

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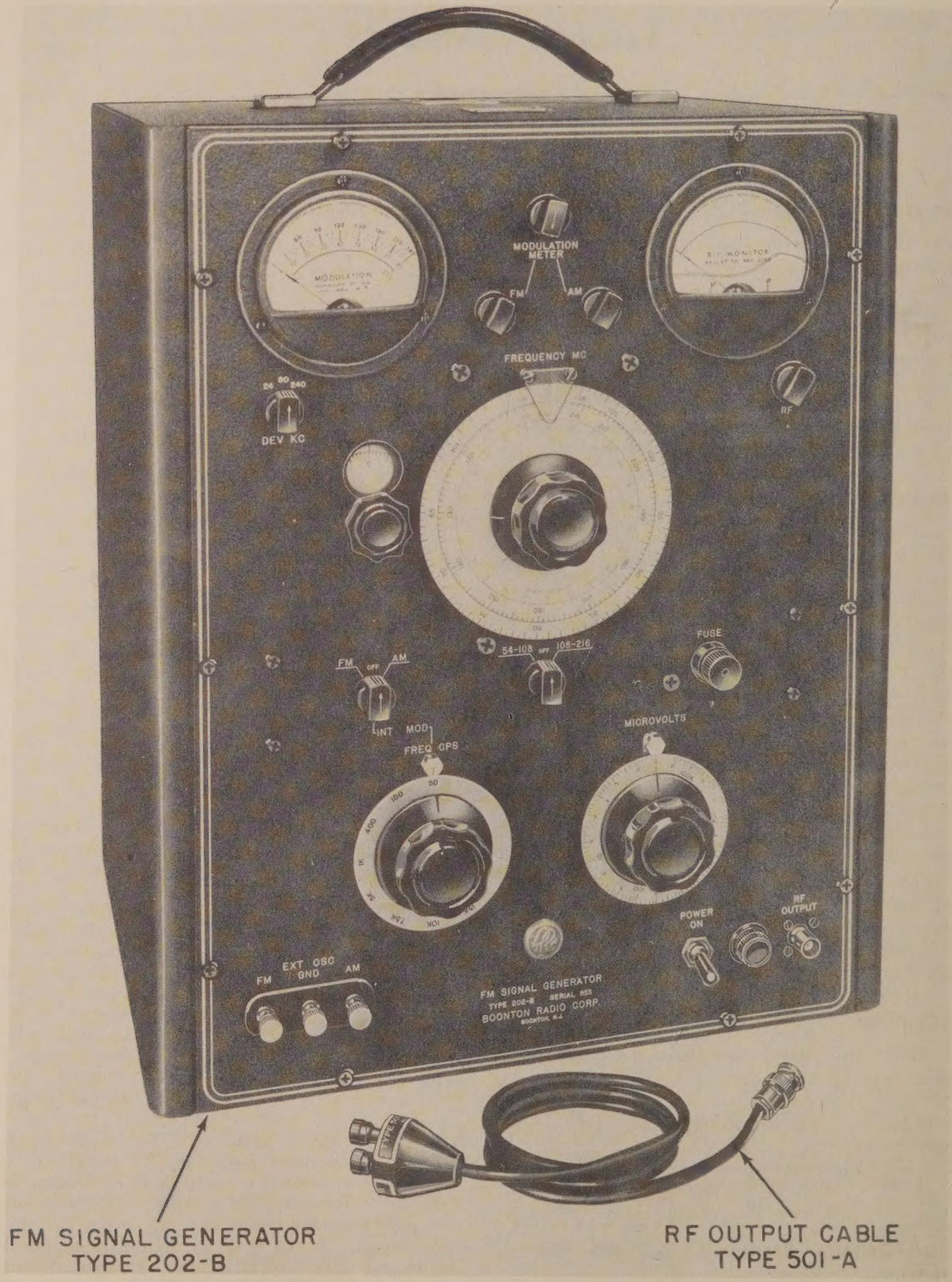


Figure 1 - 1. FM Signal Generator Type 202-B

SECTION 1

GENERAL DESCRIPTION

1-1. PURPOSE OF EQUIPMENT.

1-2. FM Signal Generator Type 202-B (figure 1-1), manufactured by Boonton Radio Corporation, Boonton, New Jersey, is a portable, self-contained signal generator designed for use in the testing, alignment, and calibration of FM radio receivers and FM sound channel equipment within the frequency range of 54 to 216 megacycles. The Type 202-B may also be used, within this frequency range, as an AM r-f signal source or, in conjunction with an external audio oscillator, to produce simultaneous FM and AM r-f signals.

1-3. DESCRIPTION OF EQUIPMENT.

1-4. FM Signal Generator Type 202-B is housed in a metal cabinet, open in front and with its rear panel louvered for ventilation. A collapsible strap-handle is secured to the top of the cabinet for carrying. All operating controls, meters, and output connections are located on the front panel. All meters and calibrated controls are direct-reading.

1-5. The Type 202-B consists of four major subassemblies. These are a panel assembly, an r-f assembly, an audio oscillator assembly, and a regulated power supply assembly. The r-f assembly is a sealed unit which is secured to the rear of the front panel. The audio assembly and the power supply are on individual chassis secured to the bottom of the equipment cabinet. Electrical connections from these units to the panel assembly and r-f assembly are made by means of suitable open-wire cable assemblies and connectors. A-c primary operating power is connected to the equipment through a two-conductor cable which is fitted with a male connector and extends from the rear wall of the cabinet.

1-6. COMPONENTS SUPPLIED.

1-7. Table 1-1 lists the components of the FM Signal Generator Type 202-B.

TABLE 1-1. COMPONENTS SUPPLIED

Quantity	*Short-Form Name*	*Type Designation*
1	FM Signal Generator	Type 202-B
1	RF Output Cable	Type 501-A

1-8. COMPONENTS REQUIRED BUT NOT SUPPLIED.

1-9. No components other than those listed in table 1-1 are required for operation of the Type 202-B.

1-10. TECHNICAL CHARACTERISTICS.

1-11. TUBE COMPLEMENT. The quantity and function of each type of tube are as follows:

Quantity	*Type Number*	*Function*
1	*6AK5	Reactance modulator
1	*6C4	R-f oscillator
1	*6AK5	Doubler
1	*6AK5	Amplifier-doubler
1	**6J5-GT/G or 6AU6	Audio oscillator
1	6V6-GT/G	Audio amplifier
1	5Y3-GT	Rectifier
1	OD3/VR-150	Voltage regulator
1	6H-6	Filament ballast

*Specially selected. See paragraph 4-7.
**6AU6 replaces 6J5-GT/G beginning with Serial No. 1125.

1-12. FUSE COMPLEMENT. The Type 202-B is protected with a type 3AG, two-ampere fuse. No spare fuses are provided.

1-13. R-F RANGE. The equipment has an over-all frequency coverage of 54 to 216 mc in two ranges: 54 to 108 mc and 108 to 216 mc.

1-14. FREQUENCY STABILITY. The frequency of the output signal is maintained within ± 0.5 per cent of the dial indication after a one-hour warm-up period.

1-15. MAIN FREQUENCY DIAL AND VERNIER FREQUENCY DIAL CALIBRATIONS. The main frequency dial ("FREQUENCY MC") is calibrated in 24 equal divisions for use with the vernier frequency dial, located to the left of it. The vernier dial is divided into 100 equal scale divisions and is coupled to the main frequency dial by a 24:1 gear train, providing a total of 2400 logging divisions over each frequency range. The approximate frequency change per vernier division is 26kc on the low range and 52kc on the high range.

1-16. R-F OUTPUT VOLTAGE. The maximum open-circuit output voltage from the "RF OUTPUT" connector is approximately 0.4 volt. With RF Output Cable Type 501-A connected, the maximum calibrated output voltage at the cable terminals is 0.2 volt. When the r-f monitor meter M-101 is set to the red calibration line and the r-f cable is attached, the r-f output attenuator control ("MICROVOLTS") is direct-reading in microvolts and continuously adjustable from 0.1 microvolt to 0.2 volt. Accuracy is approximately ± 10 per cent.

1-17. R-F OUTPUT IMPEDANCES. The r-f output impedance of the Type 202-B at the "RF OUTPUT" connector is 53 ohms, resistive. With RF Output Cable Type 501-A attached, the r-f output impedance at the cable output terminals is 26.5 ohms, resistive.

1-18. FREQUENCY MODULATION. Three frequency deviation ranges, 0 to 24 kc, 0 to 80 kc, and 0 to 240 kc, are provided, each continuously adjustable. The 0- to 24-kc deviation scale is calibrated in increments of 1 kc, the 0- to 80-kc scale in increments of 5 kc, and the 0- to 240-kc scale in increments of 10 kc, as observed on the modulation meter M-102.

1-19. AMPLITUDE MODULATION. Amplitude modulation is available over the range from 0 to 50 per cent, with calibration points on M-102 provided at 30 and 50 per cent modulation.

1-20. DISTORTION. The over-all FM distortion at 75 kc is less than 2 per cent and at 240 kc less than 10 per cent. The distortion present at the "RF OUTPUT" connector for 30 per cent amplitude modulation is less than 3 per cent, and for 50 per cent modulation less than 6.5 per cent.

1-21. SPURIOUS R-F OUTPUT. All spurious r-f output voltages are at least 30 db below the desired fundamental. Total rms spurious FM from the 60-cycle power source is down better than 50 db, with 75 kc deviation as a reference level.

1-22. FIDELITY. The deviation sensitivity of the FM modulation system as a function of frequency is constant from 0 cycles (dc) to better than 10 kc. At 15 kc the deviation as indicated on the modulation meter M-102 is 0.5 db higher than the true value. The amplitude modulation system is flat from 50 cycles to 10 kc and is down 1 db at 15 kc.

1-23. INTERNAL AF OSCILLATOR. The audio oscillator provides eight fixed frequencies: 50, 100, and 400 cycles, and 1, 5, 7.5, 10, and 15 kc, accurate to within 0.5 per cent. Harmonic distortion, in general, is less than 0.5 per cent.

1-24. EXTERNAL MODULATION REQUIREMENTS. For frequency modulation, the frequency deviation sensitivity is 50 kc per volt on the 0- to 240-kc deviation range, 16.6 kc per volt on the 0- to 80-kc deviation range and 5 kc per volt on the 0- to 24-kc deviation range. For external FM, the input impedance is 1500 ohms maximum. For amplitude modulation, approximately 45 volts is required for 50 per cent modulation on either the high or low r-f range. For external AM the maximum input impedance is 7500 ohms.

1-25. AUDIO VOLTAGE FOR EXTERNAL USE. There is available between the external "FM" and "GND" binding posts about 5 volts a-c, maximum, and between the "AM" and "GND" binding posts, 50 volts a-c, maximum.

1-26. POWER REQUIREMENTS. The equipment is designed to operate from a 115-volt, 50- to 60-cycle, a-c source; however, the equipment will operate satisfactorily over a voltage range from 105 to 125 volts a-c without changing the r-f frequency by more than 0.05 per cent.

1-27. D-C SUPPLY VOLTAGES. The internal power supply furnishes 30 ma at the unregulated 265-volt d-c output and 45 ma at the regulated 150-volt d-c output.

1-28. CURRENT REQUIREMENTS. The current drain at the nominal input voltage of 117 volts is 650 ma.

1-29. POWER CONSUMPTION. The Type 202-B consumes 65 watts at the rated input power.

1-30. DIMENSIONS. Over-all dimensions are 17 inches high x 13½ inches wide x 11½ inches deep.

1-31. WEIGHT. The total weight of the equipment is 35 pounds.

SECTION II

OPERATION PROCEDURES

2-1. OPERATING CONTROLS.

(*See figure 2-1.*)

2-2. The operating controls and their functions are listed in table 2-1 by front panel designation. The sequence of listing is clockwise around the face of the equipment, starting with the controls at the lower left.

TABLE 2-1. OPERATING CONTROLS

Designation	*Function*
"FREQ CPS"	Modulation frequency switch. Selects any one of eight fixed audio frequencies between 50 cycles and 15 kc, for either frequency or amplitude modulation.

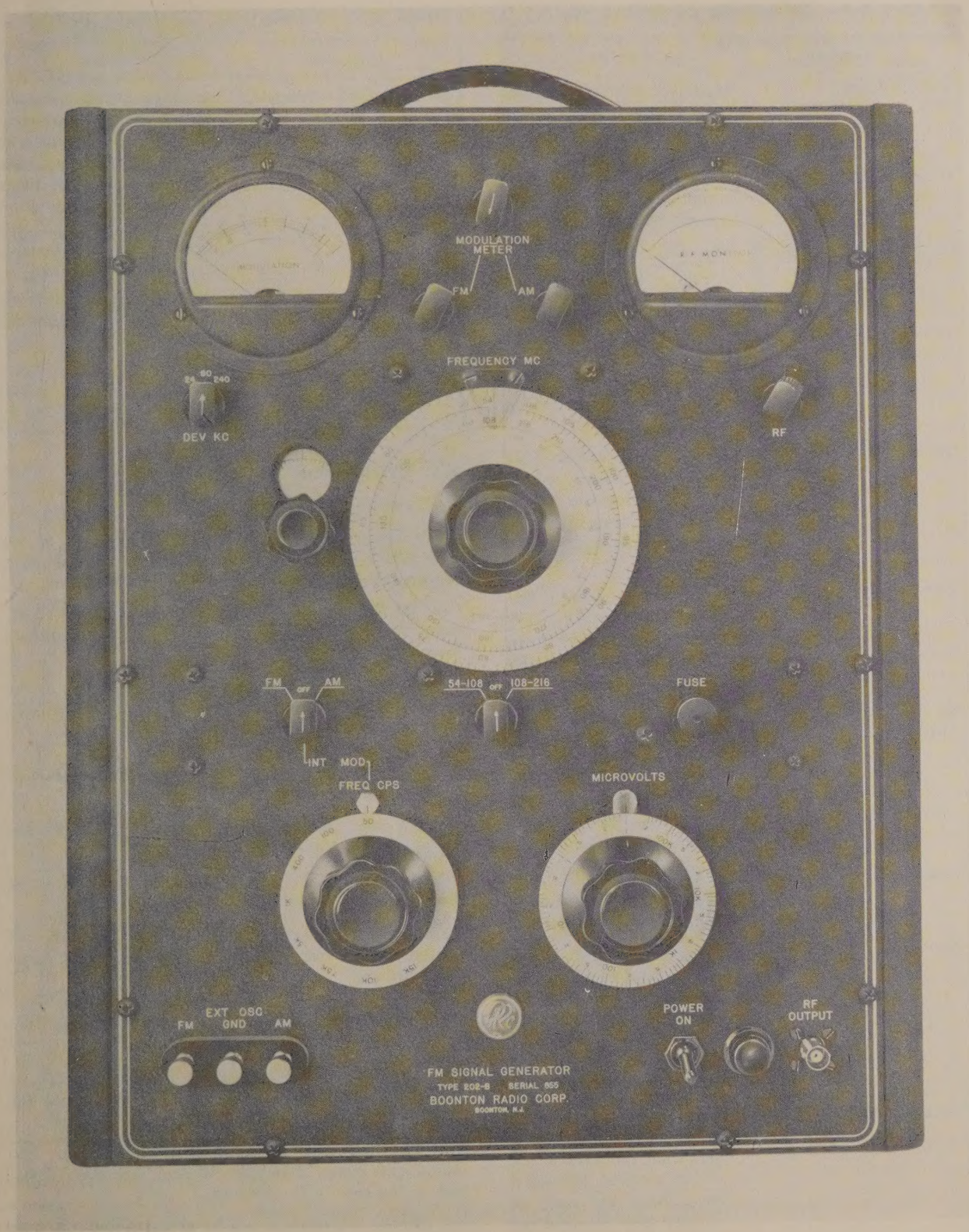


Figure 2-1. FM Signal Generator Type 202-B, Operating Controls

TABLE 2-1. OPERATING CONTROLS (Cont.)

Designation	*Function*
"FM-OFF-AM"	Modulation selector switch. Selects either frequency or amplitude modulation when set to corresponding "FM" or "AM" position. In "OFF" position turns modulation off.
VERNIER FREQUENCY	This is a reference designation, referring to the knob, which is not marked, directly to the left of the dial marked "FREQUENCY MC." Provides vernier control of the main frequency dial.
"DEV KC"	Deviation range switch. This rotary-type switch selects three modulation meter deviation ranges: 0—24 kc, 0—80 kc, and 0—240 kc.
"FM"	FM deviation control. Adjusts the frequency deviation on any of the three ranges: 0—24 kc, 0—80 kc, or 0—240 kc.
"MODULATION METER"	Modulation meter switch. Switches the modulation meter M-102, located on the left, to either the FM or AM modulating system to indicate the degree of modulation present.
"AM"	Amplitude modulation control. Adjusts the amplitude modulation level.
"RF"	R-f monitor control. Sets the r-f monitor meter M-101 to standardize the power level of the final r-f amplifier stage so that the r-f output attenuator control is direct-reading.
"FREQUENCY MC"	Main frequency dial and knob. The dial has two frequency calibrations: 54—108 mc and 108—216 mc. An inner scale is divided into 24 equal divisions for use with the vernier frequency dial.

TABLE 2-1. OPERATING CONTROLS (Cont.)

Designation	*Function*
"54–108—OFF—108–216" **Note** Hereinafter this control will be referred to as "RF RANGE"	R-f range switch. Selects either the low-frequency range, 54—108 mc or the high-frequency range, 108—216 mc, or turns the r-f carrier off.
"MICROVOLTS"	R-f output attenuator. Indicates the microvolts output at the Type 501-A output cable terminals on the directly calibrated dial.
"POWER ON"	Input power switch. Controls the primary power input to the Type 202-B.

2-3. PRELIMINARY ADJUSTMENTS.

2-4. INSTALLATION.

a. Connect the Type 202-B to a 115-volt, 50- to 60-cycle power source, by means of the a-c power cable connector P-101, available at the rear of the cabinet.

b. Set the "POWER ON" switch to the "ON" position. Allow the equipment to warm up for a minimum period of 15 minutes.

c. Connect the RF Output Cable Type 501-A to the "RF OUTPUT" connector, by pushing in on the BNC cable connector and rotating it clockwise.

2-5. CHECKING R-F OSCILLATOR AND R-F AMPLIFIER OPERATION.

a. Set the "RF RANGE" switch to either the "54—108" or "108—216" position.

b. Rotate the "RF" control, causing the pointer of the r-f monitor meter M-101 to move.

c. Check that the meter pointer can be set to the red reference mark over the entire frequency range from 54 to 216 mc.

2-6. CHECKING FM AND AM MODULATING SYSTEMS OPERATION.

a. Turn the "FM—OFF—AM" switch to "FM," the "MODULATION METER" switch to "FM," and the "DEV KC" switch to the "24" position.

b. Turn the "FM" deviation control clockwise. The modulation meter M-102 should read increasing deviation as the control is advanced.

c. Repeat the steps a. and b. of paragraph 2-6 with the "DEV KC" switch in the "80" position. Do the same with the "DEV KC" switch in the "240" position.

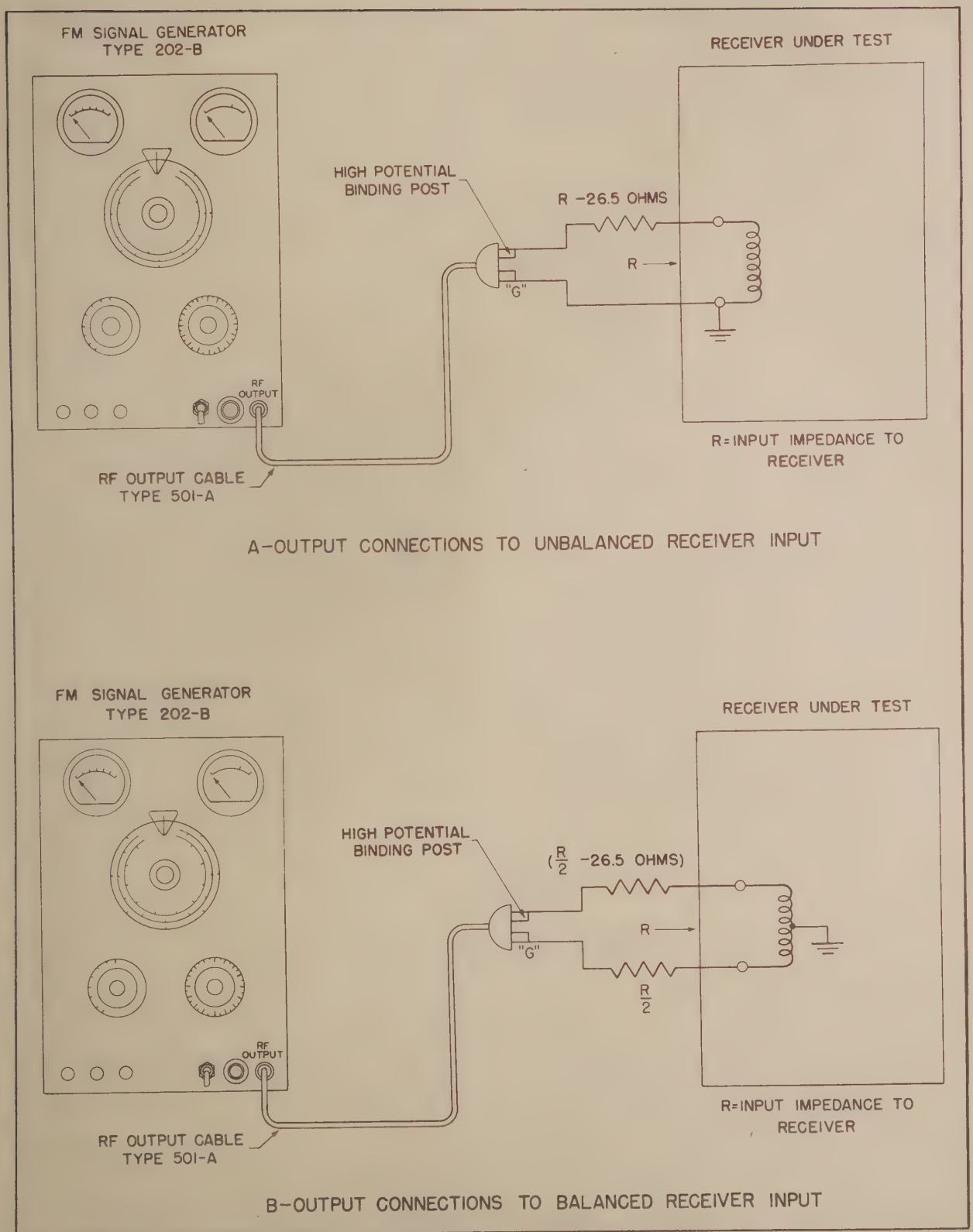


Figure 2-2. Receiver Connections to FM Signal Generator Type 202-B

d. Switch the "FM—OFF—AM" and the "MODULATION METER" switches to "AM."

e. Rotate the "AM" modulation control clockwise. The modulation meter M-102 should read the degree of amplitude modulation present and a full-scale setting should be possible as the control is advanced.

2-7. OUTPUT CONNECTIONS.

2-8. UNBALANCED RECEIVER INPUT. (*See figure 2-2.*) To match the input impedance of an unbalanced receiver, connect a resistor of suitable value from the high-potential binding post of RF Output Cable Type 501-A to the appropriate receiver terminal, and connect the "GND" binding post of the Type 501-A output cable to the receiver ground.

2-9. BALANCED RECEIVER INPUT. (*See figure 2-2.*) To match the input impedance of a balanced receiver, connect a resistor of suitable value from the high-potential binding post of the RF Output Cable Type 501-A to the appropriate receiver terminal, and connect another resistor of suitable value from the "GND" binding post to the receiver ground terminal.

CAUTION

For either balanced or unbalanced input receivers, resistors independent of frequency should be used to avoid errors due to reactance.

Note

If the ground between the Type 202-B and the receiver under test is sufficiently low, it may shunt the padding resistor in the low side of the Type 501-A cable. Check this possibility by connecting the equipment to another a-c source receptacle. Only negligible change in readings on the meters should be observed.

2-10. OPERATION.

2-11. Operation of the FM Signal Generator Type 202-B will be governed by the requirements of the tests to be performed, and by the type of equipment under test. For alignment procedures, follow the instructions outlined in the receiver handbook. Other types of tests are determined and outlined by the using facility. Reference to table 2-1 will aid in determining which controls and switch settings of the Type 202-B should be used for such tests.

2-12. SIMULTANEOUS FM AND AM. For certain tests, simultaneous FM and AM may be desired. The Type 202-B, in combination with an external low-distortion audio oscillator, may be used for this purpose, providing that the audio oscillator is capable of delivering approximately five volts across a 1500-ohm load—the FM requirement for 240 kc deviation. To use the Type 202-B for such a purpose, proceed as follows:

a. Connect the external audio oscillator to the "FM" and "GND" binding posts.

b. Set the "FM—OFF—AM" switch to "AM."

c. Adjust the levels of each type of modulation independently on the modulation meter by operation of the "MODULATION METER" switch, "FM" deviation control, and the "AM" modulation control.

CAUTION

The use of an external audio oscillator for AM, with the "FM—OFF—AM" switch on "FM," will result in interaction between the modulation circuits when both oscillators are operating at or near the same audio frequency.

SECTION III

THEORY OF OPERATION

3-1. PRINCIPLES OF OPERATION.

(*See figures 3-1 and 3-2.*)

3-2. The principal stages of FM Signal Generator Type 202-B are a reactance modulator, an r-f oscillator, a doubler, and an r-f output stage which functions either as an amplifier or second doubler. These four stages form the r-f assembly. In addition, the signal generator includes an audio oscillator and an audio amplifier mounted on a separate chassis. The necessary plate and screen voltages are furnished by a separately mounted single-phase, full-wave, regulated power supply. A piston-type mutual inductance attenuator is coupled to the output stage.

3-3. The r-f oscillator, V-102, is tuned over the frequency range from 27 to 54 mc. The r-f oscillator is reactance-modulated by V-101, which, for frequency modulation, shifts the frequency of the oscillator in direct proportion to the instantaneous audio voltage applied to the reactance tube from the audio modulating oscillator V-105.

3-4. The output of V-102, the r-f oscillator, is fed to a class C frequency doubling stage, V-103, which is tuned to the second harmonic of the r-f oscillator frequency, and covers a frequency range from 54 to 108 mc. The output of V-103 is fed to V-104, the r-f output stage. In the low frequency range of 54 to 108 mc, V-104

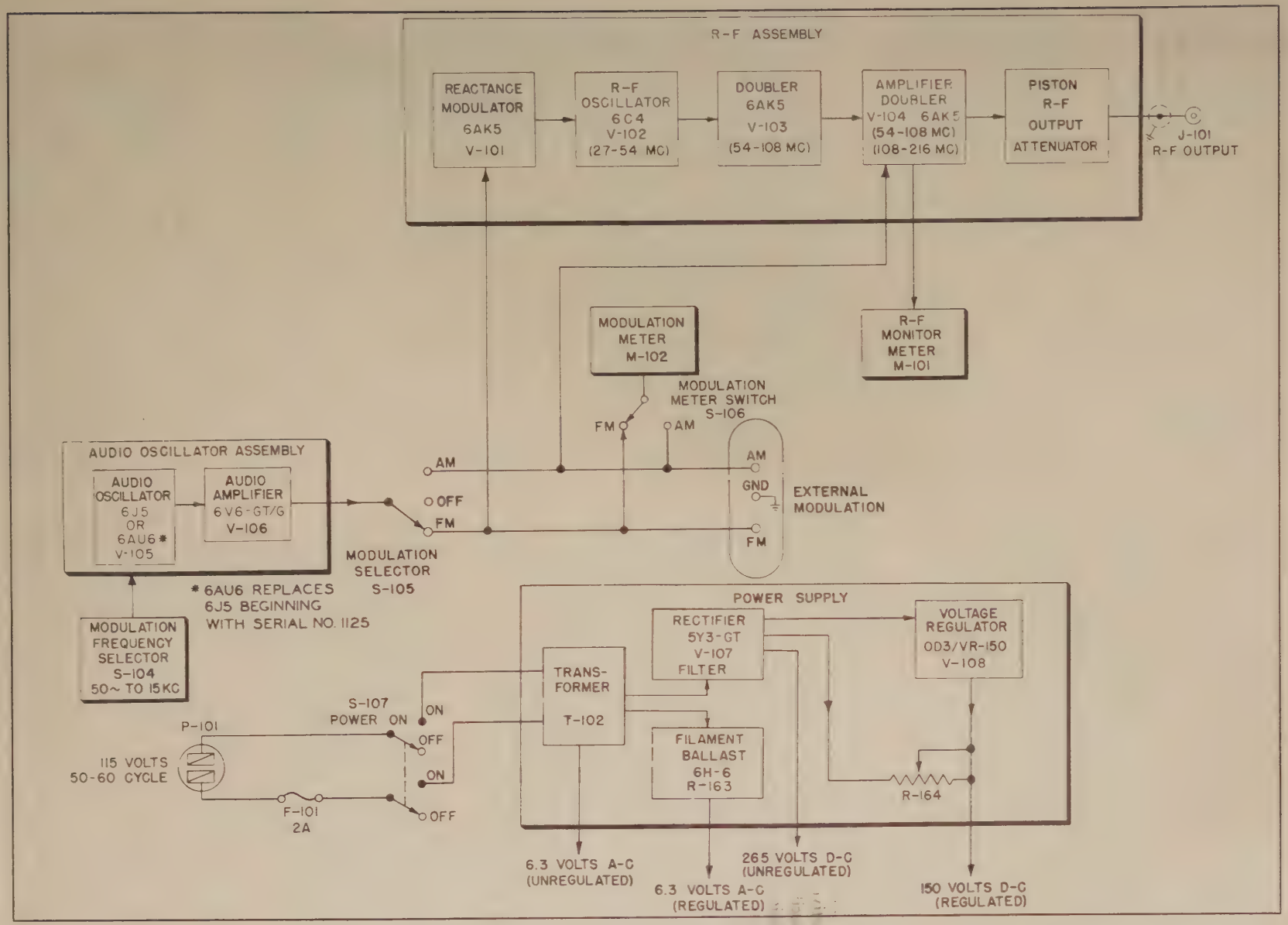


Figure 3-1. FM Signal Generator Type 202-B, Block Diagram

operates as a conventional class C amplifier. For the upper frequnecy range of 108 to 216 mc, V-104 functions as an additional doubler. Amplitude modulation is provided by an audio modulating voltage obtained from V-105 and applied to the screen grid of V-104.

3-5. The plate inductor L-105 of the r-f output stage is coupled to a piston-type mutual inductance attenuator L-106, which has a resistor, R-118, in series with the one-turn coupling loop. When the power output from V-104 is set to the proper level, as indicated by the r-f monitor meter M-101, the attenuator dial ("MICRO-VOLTS"), located on the front panel, will indicate a microvolt reading in terms of the voltage present at the terminal posts of the Type 501-A output cable.

3-6. REACTANCE MODULATOR.

(See figure 3-2.)

3-7. The reactance modulator employs a type 6AK5 pentode vacuum tube (V-101) operating as a controllable inductive element across the tuned tank circuit of the r-f oscillator. In order to maintain constant frequency deviation sensitivity over the entire tuning range of the Type 202-B, the amount of inductance injected by V-101 is made to vary directly as the carrier frequency. This is accomplished by the bridged-tee network consisting of R-101, R-102, C-102, the grid-to-cathode capacitance of V-101, and the grid-to-plate capacitance of V-101. This type of network would be capable of constant-deviation operation over a frequency range of about 2 to 1, if all detail parts were fixed. However, in order to provide the precision of deviation calibration, C-102 is made variable and is ganged with C-108, the r-f oscillator tuning capacitor. The stator of C-102 is slotted and factory-adjusted by bending the stator sections to make the deviation as constant as desired over the frequency range.

3-8. The cathode bias resistors R-104 and R-105 are bypassed by C-103 for rf only, so that at audio frequencies degeneration occurs. R-105 is used to adjust the amount of degeneration present in order to provide the desired deviation sensitivity. The cathode bias provided by R-104 and R-105 is controlled by R-108, which serves to bleed the proper amount of current through R-104 and R-105, thereby permitting V-101 to operate over the linear portion of its characteristics.

3-9. On the "108-216" position of S-101, the "RF RANGE" switch, the modulation voltage for frequency modulation is reduced to one-half, in order to maintain the same frequency deviation. This is accomplished by means of R-154, R-155, and S-102, which is mechanically coupled to the shaft of S-101. S-103, the deviation range switch ("DEV KC"), reduces the modulating voltage applied at the reactance tube to one-third, when operated from the "240" kc deviation position to the "80" kc deviation position, and to one-tenth, when operated from the "240" position to the "24" kc deviation position.

3-10. For FM, an audio modulating voltage is applied directly to the grid of V-101 through an r-f filter consisting of C-125, L-111, C-124, L-110, C-123, and R-120. This is a low-pass filter which prevents stray r-f currents, which would affect the output at low levels, from leaking out of the shielded portion of the signal generator.

3-11. R-F OSCILLATOR.

(See figure 3-2.)

3-12. The r-f oscillator employs a type 6C4 triode vacuum tube (V-102) in a tuned plate oscillator circuit. This stage covers the frequency range from 27 to 54 mc. Tuning over this range is accomplished by C-108 which is ganged to the other two variable tuning capacitors C-114 and C-118. Approximately 150 volts dc is applied to the plate of V-102 through L-101. The r-f oscillator voltage output is coupled to the grid of V-103 through C-107.

3-13. DOUBLER.

(See figure 3-2.)

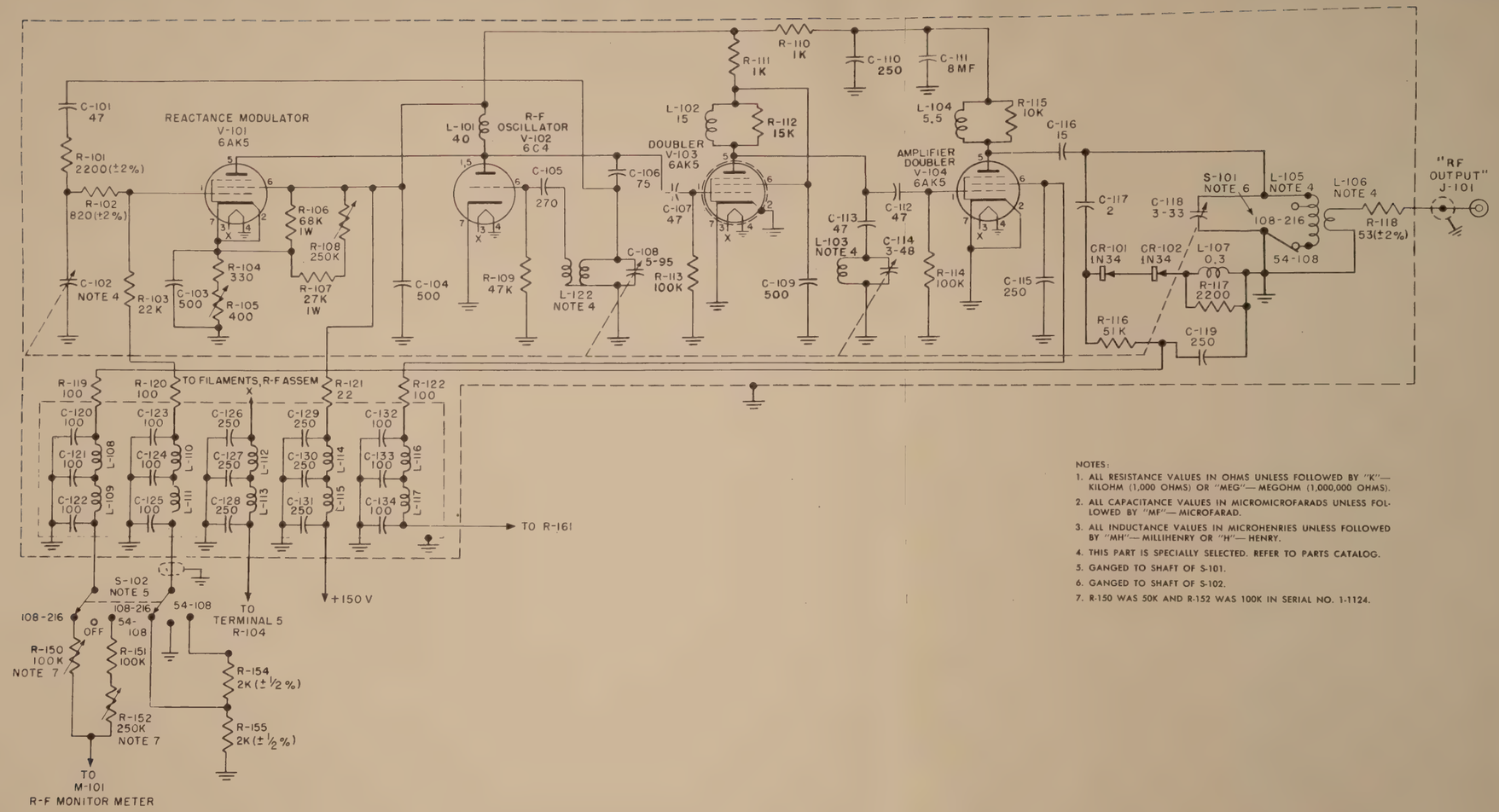
3-14. The frequency of the r-f oscillator is multiplied in the plate circuit of V-103, a type 6AK5 pentode vacuum tube, which operates as a conventional self-biased class C doubler. The use of a doubler stage permits the r-f oscillator to be operated at a lower frequency and provides the desired isolation between the oscillator and the r-f output stage. In addition, it provides sufficient drive to saturate the output stage and thus remove any spurious AM up to this point. The tuned plate circuit consists of variable capacitor C-114 and the tank coil L-103. C-114 is ganged with C-108, the r-f oscillator tuning capacitor, so that the doubler tracks with the r-f oscillator.

3-15. L-102 and R-112 provide isolation between stages. Insofar as rf is concerned, L-102 appears as an inductive load in the plate circuit of V-103. The resistor R-112 is shunted across L-102 to lower the Q, since under the conditions noted, the Q of the tank circuit is too high to permit proper operation of the Type 202-B on FM, due to an excessive amount of amplitude modulation present. At frequencies beyond the self-resonant frequency, L-102 appears as a capacitance, thereby lowering the impedance presented to the plate. To lower the Q of the circuit within the frequency bandwidth, the required amount of distributed capacitance, inductance, and resistance is furnished by L-102 and R-112.

3-16. AMPLIFIER DOUBLER.

(See figure 3-2.)

3-17. The r-f output stage employs a type 6AK5 pentode vacuum tube (V-104) operating in class C. For the low r-f range, this stage functions as an amplifier, and for the high range serves as a frequency doubler: in effect, a frequency quadrupler of the r-f oscillator fundamental frequency. The output tank coil L-105 is provided with two contact points so that when the ground contact arm is switched from the "54-108" position to the "108-216" position by operation of S-102 which is ganged to the



NOTES:

1. ALL RESISTANCE VALUES IN OHMS UNLESS FOLLOWED BY "K"— KILOHM (1,000 OHMS) OR "MEG"— MEGOHM (1,000,000 OHMS).
2. ALL CAPACITANCE VALUES IN MICROMICROFARADS UNLESS FOLLOWED BY "MF"— MICROFARAD.
3. ALL INDUCTANCE VALUES IN MICROHENRIES UNLESS FOLLOWED BY "MH"— MILLIHENRY OR "H"— HENRY.
4. THIS PART IS SPECIALLY SELECTED. REFER TO PARTS CATALOG.
5. GANGED TO SHAFT OF S-101.
6. GANGED TO SHAFT OF S-102.
7. R-150 WAS 50K AND R-152 WAS 100K IN SERIAL NO. 1-1124.

Figure 3-2. R-F Assembly, Schematic Diagram

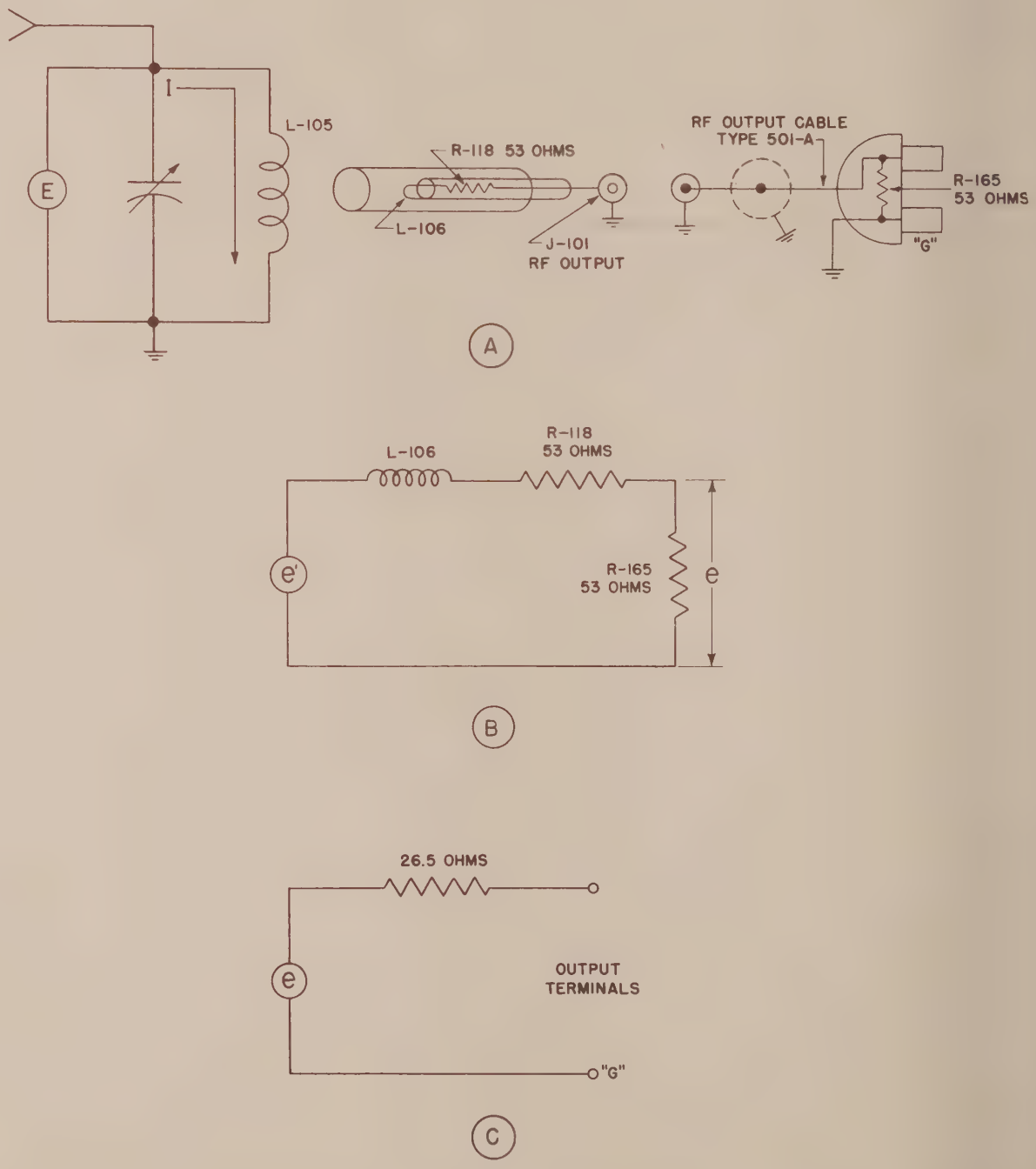
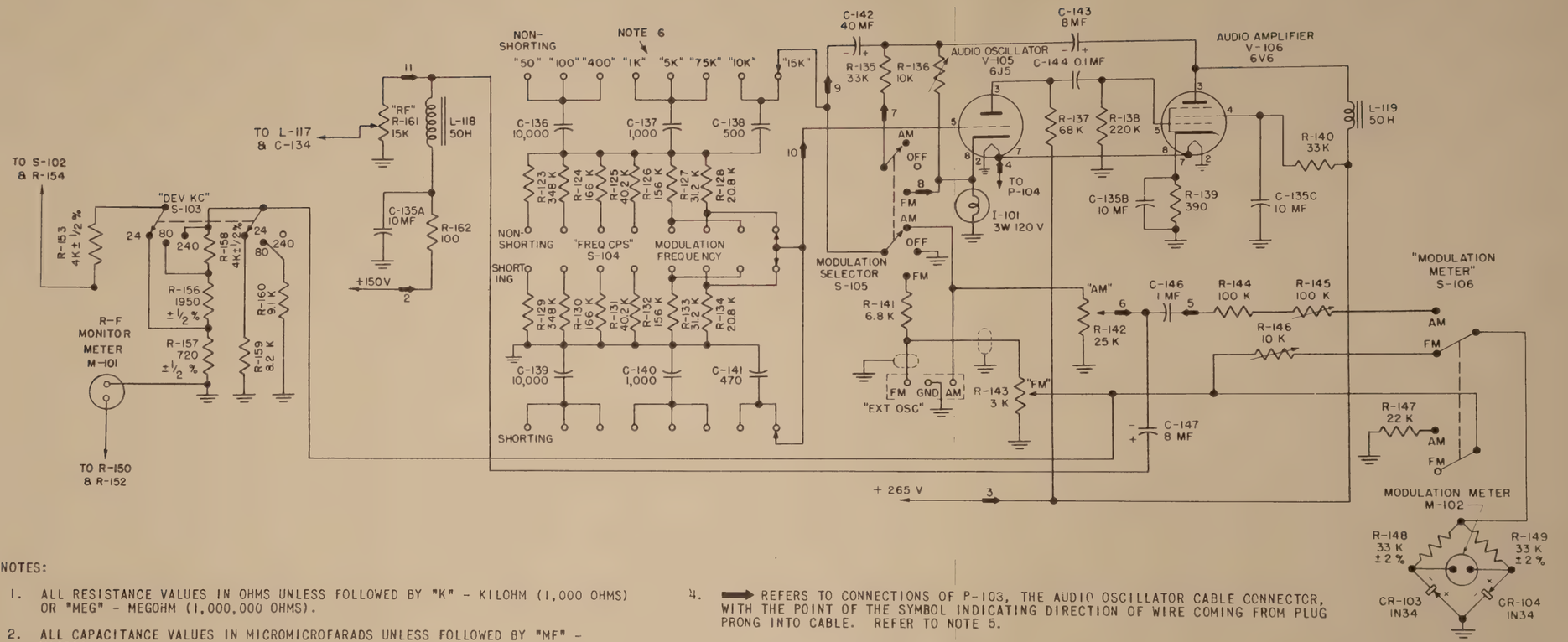


Figure 3-3. Output Attenuator, Equivalent Circuit Diagram



NOTES:

1. ALL RESISTANCE VALUES IN OHMS UNLESS FOLLOWED BY "K" - KILOHM (1,000 OHMS) OR "MEG" - MEGOHM (1,000,000 OHMS).
2. ALL CAPACITANCE VALUES IN MICROMICROFARADS UNLESS FOLLOWED BY "MF" - MICROFARAD.
3. ALL INDUCTANCE VALUES IN MICROHENRIES UNLESS FOLLOWED BY "MH" - MILLIHENRY OR "H" - HENRY.
4. ➡ REFERS TO CONNECTIONS OF P-103, THE AUDIO OSCILLATOR CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE. REFER TO NOTE 5.
5. PIN 1 OF P-103 CONNECTS TO GROUND.
6. FREQUENCIES IN CPS OF AUDIO OSCILLATOR FOR GIVEN POSITIONS OF S-104.

Figure 3-4. Audio Oscillator Assembly and Panel Assembly, Schematic Diagram (Serial No. 1-1124)

shaft of S-101, the inductance of the tank coil is changed to double the resonant frequency of the tank circuit. Tuning of C-118 in the "108-216" position, therefore, tunes the plate circuit of V-104 to the second harmonic of the input frequency applied to the grid of V-104. Switching the load inductance is accomplished by two spring contact fingers, one or the other of which is pressed against a contact point by insulated members on S-101.

3-18. L-104 and R-115 are an isolation network and serve the same purpose at L-102 and R-112 of the doubler stage. (Refer to paragraph 3-15.)

3-19. Amplitude modulation is produced by modulating the screen circuit of V-104, sufficient isolation from the power supply being provided by the 50-henry choke, L-118.

3-20. OUTPUT ATTENUATOR.

(See figure 3-2.)

3-21. A mutual inductance (piston-type) r-f output attenuator, having an internal impedance of 53 ohms, is inductively coupled to the tank coil, L-105, of the r-f output stage. To provide continuously adjustable attenuation, the pickup loop of the attenuator can be moved along the axis of the attenuator tube by means of a rack and pinion drive. The output cable is type RG 58/U, which has a nominal impedance of 53 ohms. To keep the output impedance of the generator constant, a 53-ohm resistor (R-118) is placed in series with coupling loop L-106 and another is used to terminate RF Output Cable Type 501-A.

3-22. An equivalent circuit of the output attenuator is shown in figure 3-3. The voltage induced in the attenuator coupling loop L-106 is a function of the tank voltage across L-105 and C-118 and the coefficient of coupling between L-105 and L-106. (See A of figure 3-3.) The attenuation law of the piston controls the coefficient of coupling factor, while the tank voltage is monitored by the r-f monitor meter, M-101.

3-23. From B of figure 3-3, it can be shown that the voltage *e* across the terminating resistor is equal to one-half the voltage induced in the attenuator coupling loop L-106.

Note

Since L-106 is less than 0.01 microhenry, it can be neglected in comparison with the total resistance present.

3-24. Neglecting L-106, an application of Thevenin's theorem yields the equivalent circuit shown in C of figure 3-3. Thus, the Type 202-B with its r-f output cable can be represented as a source voltage *e* in series with a resistance of 26.5 ohms. The attenuator dial ("MICROVOLTS") is calibrated in terms of the open-circuit voltage *e* shown in C of figure 3-3 and is direct-reading in microvolts from 0.1 microvolt to 0.2 volt, when the r-f monitor meter M-101 is set to the red reference line.

3-25. AUDIO OSCILLATOR AND AUDIO AMPLIFIER.

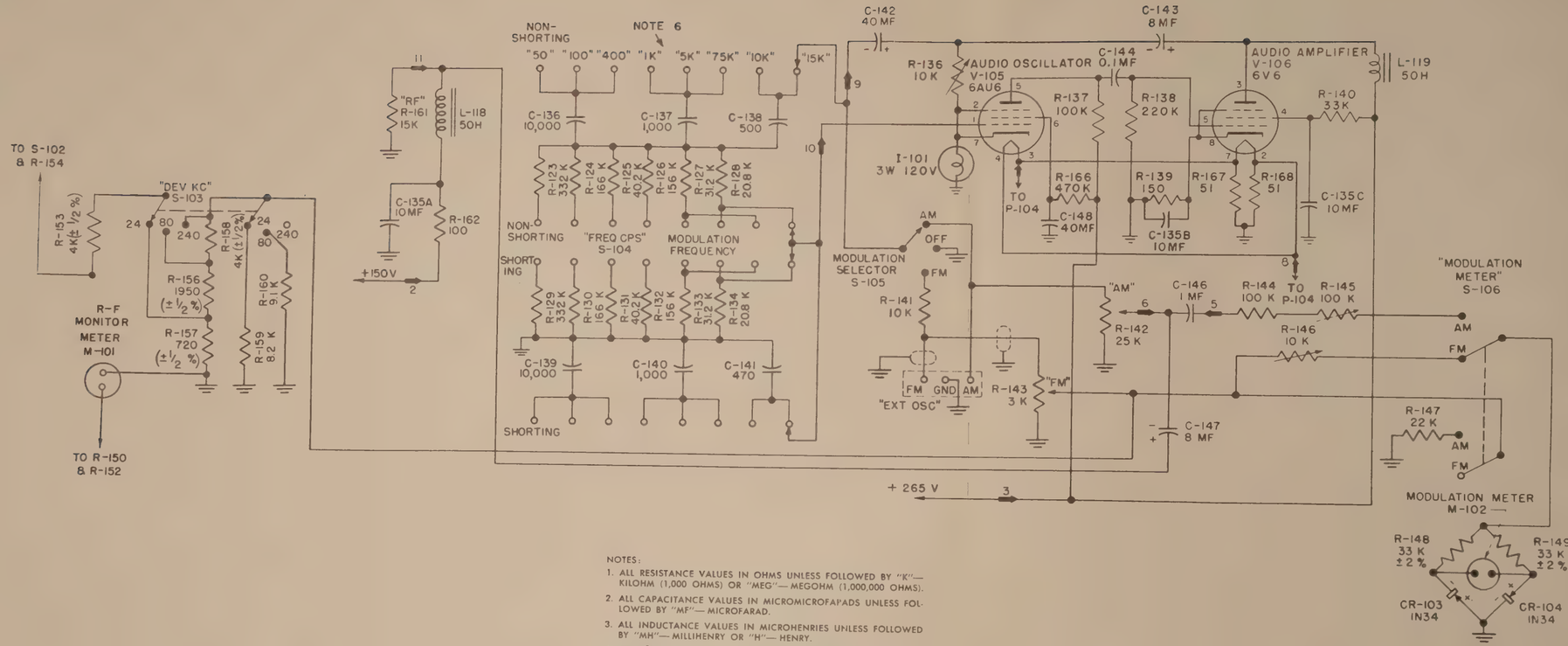
(See figures 3-4 and 3-4A)

3-26. The audio oscillator stage serves for either amplitude modulation or frequency modulation, since the power requirements for each type of modulation are small and compare favorably with each other. The circuit is a resistance-capacitance type oscillator whose detail parts are connected in a Wien bridge circuit. The FM Signal Generator Type 202-B with serial numbers below 1125 employs a type 6J5-GT/G triode vacuum tube (V-105) as the oscillator and a 6V6-GT/G (V-106) as the audio amplifier. Beginning with Serial No. 1125, a type 6AU6 pentode vacuum tube is used as the oscillator. The modulation frequencies desired are provided by the series and shunt resistor-capacitor combinations, which form the feedback networks. These consist of R-123 through R-134 and C-136 through C-141. These are mounted directly on the rotary-type modulation frequency switch, S-104, which is located on the rear of the front panel with its operating knob available from the front. Connections from S-104 to the audio chassis are made by means of two leads connected to X-110, the 11-terminal mating connector for P-103 of the audio chassis cable, W-104.

3-27. The negative feedback elements are connected in a bridge circuit to make the oscillator frequency selective. Oscillation takes place when the input signal to V-105 is in phase with the output voltage of V-106 and when the positive feedback voltage exceeds the negative feedback voltage. R-136 regulates the amount of negative feedback voltage provided by the resistor-capacitor voltage divider circuits selected by operation of S-104. The lamp I-101 is used as the cathode resistor of V-105 in order to stabilize the amplitude of oscillation. If the amplitude of oscillation tends to increase, the current through the lamp tends to increase, increasing the effective resistance of the lamp filament. A greater negative feedback voltage is developed across this resistance, which in turn provides more degeneration. The gain of V-105 is reduced, thereby holding the output voltage at a nearly constant amplitude. The action of I-101 also tends to prevent distortion of the sinusoidal waveform of the output, the oscillator having, in general, a total harmonic content of less than 0.5 per cent.

3-28. The output of the oscillator is coupled to V-106 through C-144. Approximately 50 volts is obtained from the plate of V-106 for modulating purposes, the exact value being controlled by R-136.

3-29. Both shorting and nonshorting contacts are used in S-104. These are employed to keep the grid of V-106 returned to ground, during the switching process, when the resistor-capacitor elements are connected in shunt. This prevents the discharge of the capacitors, and the consequent high current on the grid, from reaching the potential of the plate.



NOTES:

1. ALL RESISTANCE VALUES IN OHMS UNLESS FOLLOWED BY "K"— KILOHM (1,000 OHMS) OR "MEG"— MEGOHM (1,000,000 OHMS).
2. ALL CAPACITANCE VALUES IN MICROMICROFARADS UNLESS FOLLOWED BY "MF"— MICROFARAD.
3. ALL INDUCTANCE VALUES IN MICROHENRIES UNLESS FOLLOWED BY "MH"— MILLIHENRY OR "H"— HENRY.
4. ➡ REFERS TO CONNECTIONS OF P-103, THE AUDIO OSCILLATOR CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE. REFER TO NOTE 5.
5. PIN 1 OF P-103 CONNECTS TO GROUND.
6. FREQUENCIES IN CPS OF AUDIO OSCILLATOR FOR GIVEN POSITIONS OF S-104.

Figure 3-4A. Audio-Oscillator Assembly and Panel Assembly, Schematic Diagram (Serial No. 1124 and Following)

3-30. POWER SUPPLY.

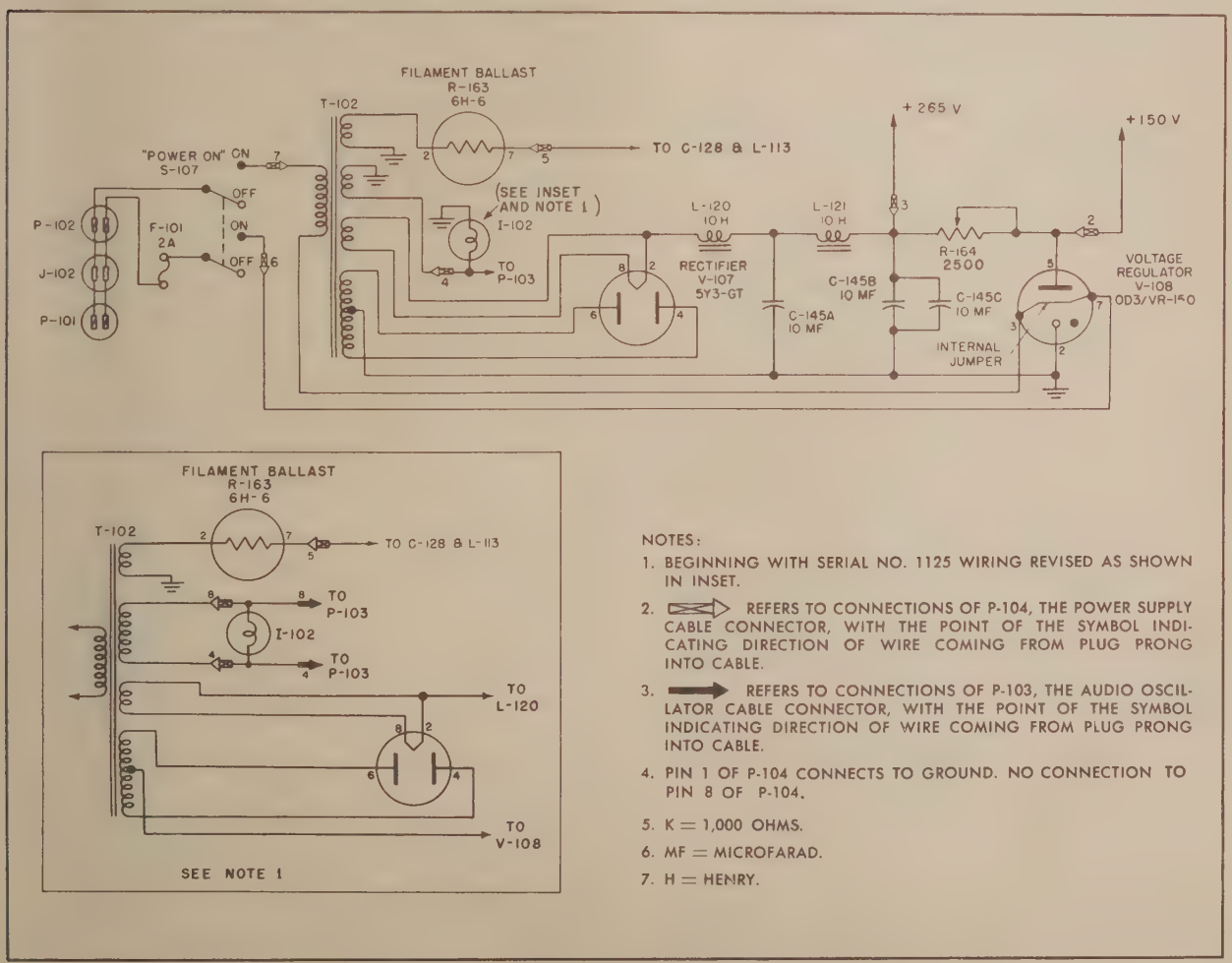
(See figure 3-5.)

3-31. Primary power of 115 volts, 60-cycle, is brought in through P-101, J-102, and P-102, and is controlled by S-107 for application to the primary winding of T-102. This circuit is protected by a 2-ampere fuse, F-101. The secondary of T-102 furnishes all plate, screen, and filament voltages, as well as the necessary voltage to light the power-on-indicator panel lamp, I-102.

3-32. The plate supply employs a 5Y3-GT (V-107) in a single-phase, full-wave rectifier circuit, with a two-section, choke-input filter consisting of L-120, L-121, C-145A, C-145B, and C-145C; C-145B and C-145C being connected in parallel to form an effective capacitance of 20 microfarads. The supply is regulated by means of an OD3/VR-150 (V-108). R-164 is a variable resistor which allows application of the initial high ionizing voltage for V-108. When the plate supply load warms up and draws current through R-164, it reduces the plate supply voltage to the proper value for V-108. It also serves to reduce the high voltage to the required screen voltage value. The d-c supply furnishes 30 ma at 265 volts d-c, unregulated, and 45 ma at 150 volts d-c, regulated.

3-33. Filament voltage for all 6.3-volt filaments is supplied from two separate windings of T-102. One winding furnishes the necessary voltage to the r-f assembly vacuum tubes; the other furnishes the necessary voltage to the audio oscillator assembly vacuum tubes and panel indicator lamp. Beginning with Serial No. 1588, the filament circuit of V-105 and V-106 was center tapped to ground through two 51-ohm resistors (R-167 and R-168) to reduce hum modulation. (See figure 3-4A.) R-163 is a type 6H-6 ballast tube connected in series with the filament circuit of the r-f assembly vacuum tubes. It is employed to regulate the filament voltage with variations in primary voltage.

3-34. Output connections are made by means of P-104 of the power supply cable W-105 through the octal connector X-111 mounted on the rear of the panel assembly.



NOTES:

1. BEGINNING WITH SERIAL NO. 1125 WIRING REVISED AS SHOWN IN INSET.
2. ⋈ REFERS TO CONNECTIONS OF P-104, THE POWER SUPPLY CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE.
3. ➡ REFERS TO CONNECTIONS OF P-103, THE AUDIO OSCILLATOR CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE.
4. PIN 1 OF P-104 CONNECTS TO GROUND. NO CONNECTION TO PIN 8 OF P-104.
5. K = 1,000 OHMS.
6. MF = MICROFARAD.
7. H = HENRY.

Figure 3-5. Power Supply, Schematic Diagram

SECTION IV

PERIODIC INSPECTION AND MINOR REPLACEMENT OR REPAIR

4-1. PERIODIC INSPECTION.

4-2. FM Signal Generator Type 202-B should be inspected at definite intervals to insure maximum operating efficiency. Table 4-1 lists the inspections required. The inspection periods suggested are the minimum requirements under normal operating conditions and may therefore be advanced, if deemed necessary, by the operating facility. All work is performed while the power is turned off. Weekly inspections do not require removal of the assemblies from the cabinet; annual inspections do.

TABLE 4-1. PERIODIC INSPECTION CHART

WHAT TO INSPECT	*WHAT TO INSPECT FOR*
Weekly	
Cabinet	Severe dents; scratched, rusted, or chipped surfaces; dirt; loose panel screws; loose or damaged strap handle.
Meters	Cracked or broken cover glasses; dirt; zero-setting.
Control knobs	Cracks, breaks, or dirt; obscured indicator and dial markings.
Fuse holder and fuse	Defective fuse, cracked or broken fuse holder.
Terminal posts	Dirt, loose posts, stripped threads, cracks or breaks in insulating mounting plate.
Power switch	Check that mechanical action is smooth and that switch is secure.
Pilot lamp	Cracked or broken jewel, loose fit in lamp socket, possible socket contact corrosion.
Output connector	Loose mounting, broken cable connection, stripped threads.

TABLE 4-1. PERIODIC INSPECTION CHART (Cont.)

WHAT TO INSPECT	*WHAT TO INSPECT FOR*
Annually	
Exterior	
Cabinet	All "WEEKLY" inspections, deterioration of a-c power cable insulation, security and general condition of connectors.
Panel and Meter Assembly	
Front of panel	All "WEEKLY" inspections.
Meters	Cracks or breaks in cases, loose or corroded terminals.
Rotary switches	Dirty contacts, loose mounted detail parts, dirty or loose solder connections. Check for positive action by operating front panel controls.
Connectors	Dirty contacts, loose connections.
Terminal board	Dirt; loose mounting screws or mounted parts; blistering, charring or other signs of overheating of mounted parts.
Potentiometers	Loose or dirty terminal connections. Check for positive action by operating front panel controls.
Wiring	Poor insulation, cracks, evidence of dry rot, loose connections.
R-F Assembly	
Note Interior inspection of the r-f assembly, which is a sealed, dust-proof unit, is not recommended. Interior inspection is indicated only if trouble is definitely localized to the r-f unit. (Refer to paragraph 6-20.)	
Shield	Broken glyptal seals, dirt, severe dents, loose screws.

TABLE 4-1. PERIODIC INSPECTION CHART (Cont.)

WHAT TO INSPECT	*WHAT TO INSPECT FOR*
Annually	
Gears	Dirt, broken teeth, insufficient lubrication. Check for positive action (no binding or backlash) by operating "FREQUENCY MC" control.
Attenuator	Dirt; broken teeth on rack and pinion; deterioration; cracks, or severe bends in cable; loose cable connection. Check for positive action by varying front panel control.
Potentiometers	Loose mounting or locknuts.
Audio Assembly	
Vacuum tubes and lamp	Cracked, broken, or loose envelopes; loose base pins; dirty or corroded base pins.
Sockets	Dirty or corroded terminals; cracks or breaks; loose mounting rivets.
Chokes	Blistering or other signs of overheating, loose or dirty terminal connections, security of mounting.

TABLE 4-1. PERIODIC INSPECTION CHART (Cont.)

WHAT TO INSPECT	*WHAT TO INSPECT FOR*
Annually	
Capacitors	Leaks, excessive wax drippings, loose mounting brackets.
Resistors	Blistering, discoloration, or other indications of overheating; corroded or loose leads; loose solder connections.
Terminal board	Cracks, breaks, loose mounting or mounted parts.
Wiring	Poor insulation, cracks, evidence of dry rot.
Chassis	Dirt, loose threaded studs.
Power Supply	
General	All applicable inspections listed under "Audio Assembly."
Transformer	Blistering, leakage of insulating compound, or other signs of overheating; loose mounting, wiring, and connections.

4-3. LUBRICATION.

(*See figure 4-1.*)

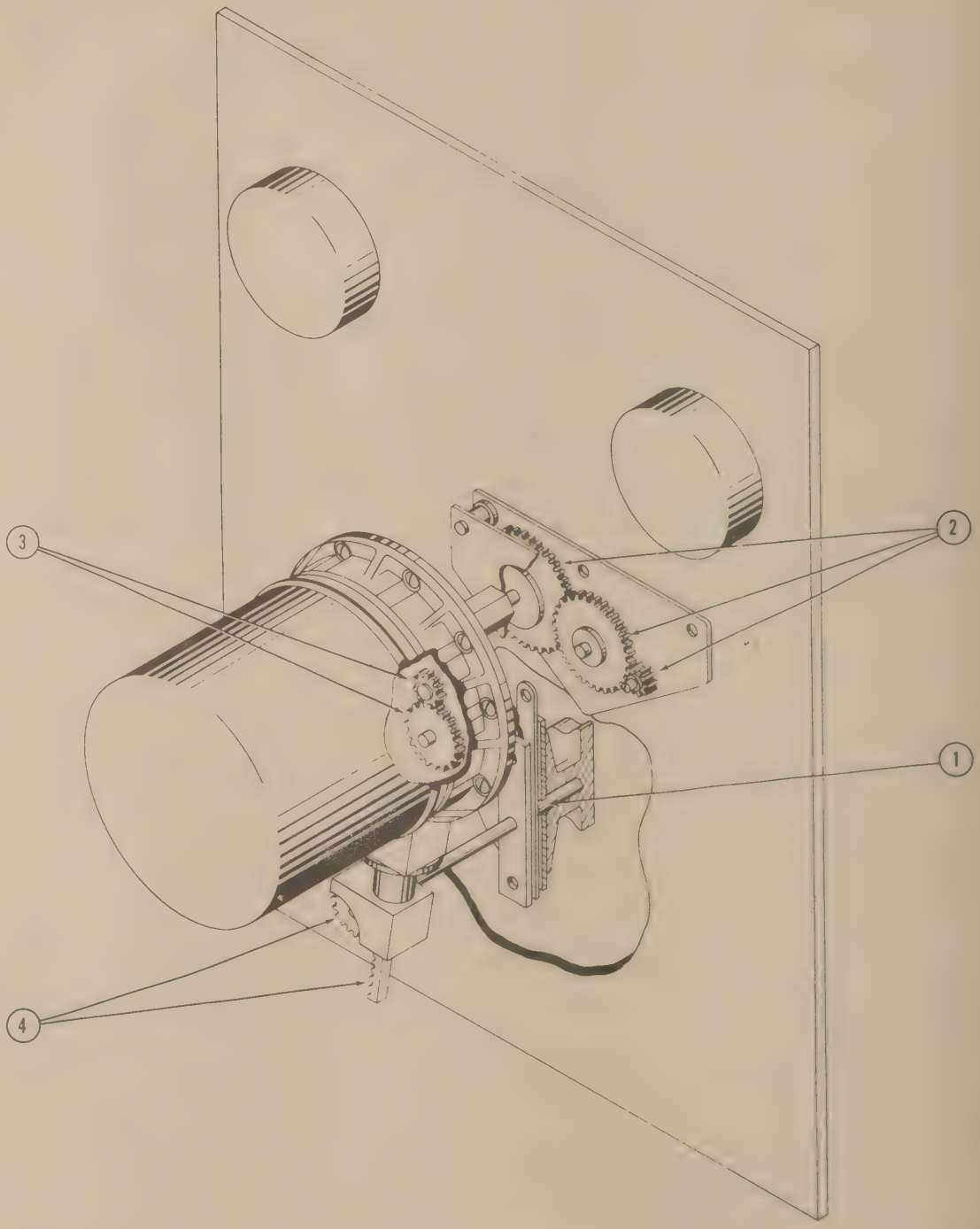
4-4. Lubrication information for the Type 202-B is listed in table 4-2.

TABLE 4-2. LUBRICATION DATA

Lubrication Point	*Type of Lubricant*	*AN or Commercial Specification*	*Period*	*Method of Lubrication*
Attenuator shaft bearing (1, figure 4-1)	Oil	Davenoil*	Annually	Apply two drops to shaft in fiducial plate bearing.
R-f assembly gears (2, figure 4-1)	Oil	Davenoil*	Annually	Apply sparingly to all gear teeth in gear drive housing and to mating teeth.
R-f range switch gears and bearings (3, figure 4-1)	Oil	Davenoil*	Annually	Apply sparingly to gears and their bearings.
Attenuator rack and pinion (4, figure 4-1)	Grease	Lubriplate No. 105†	Annually	Apply thin coat to gear rack and pinion.

* Davenoil Co., Newark, New Jersey.

† Fiske Bros. Refining Co., Newark, New Jersey.



1. Attenuator shaft bearing
2. R-f assembly gears
3. R-f range switch gears and bearings
4. Attenuator rack and pinion

Figure 4-1. Lubrication Diagram

4-5. REPLACEMENT OF VACUUM TUBES.

4-6. All tubes supplied with FM Signal Generator Type 202-B have a life expectancy of approximately 1,000 hours. Since no absolute discard data exist for these tubes, they may be used until proven defective. All tubes except those contained within the sealed r-f assembly are accessible for replacement after the panel assembly has been removed from the cabinet enclosure.

4-7. When troubles are localized to the tubes within the r-f assembly, specially selected tubes are required for replacement. Replacement tubes must be aged for a period of four days before being used and must conform to the following transconductance (G_m) data:

Symbol	*Tube*	*Function*	G_m *(umhos)*
V-101	6AK5	Reactance modulator	4000-4500
V-102	6C4	R-f oscillator	2000-3000
V-103	6AK5	Doubler	4000-4500
V-104	6AK5	Amplifier-doubler	4500-5000

4-8. Standard maintenance procedures are followed for the removal and replacement of vacuum tubes located on the audio and power supply chassis (refer to paragraph 4-9). Figures 6-3 and 6-5 illustrate the location of all accessible vacuum tubes employed in the Type 202-B.

4-9. When replacing V-108, it is desirable to check its current drain by placing a milliammeter in series with the plate and adjusting R-164 for a plate current reading of 7.0 ma with the input voltage to T-102 adjusted to 105 volts by means of a variable transformer. This adjustment will insure proper operation of the power supply over an input voltage range of 105 to 125 volts.

4-10. REPLACEMENT OF FUSE.

4-11. The input circuit of the Type 202-B is protected by a type 3AG, 2-ampere cartridge fuse, located in an extractor-type fuse holder on the front panel. To replace the fuse, rotate the fuse holder cap a quarter-turn counterclockwise, remove the cap, and extract the defective fuse. Insert a new fuse and replace the cap securing in position by pushing in and rotating the cap clockwise.

4-12. REPLACEMENT OF LAMPS.

4-13. The audio chassis (see figure 6-3) contains a 3-watt, 120-volt, candelabra-base lamp (I-101) mounted in a suitable socket on the top of the chassis. To replace this lamp, loosen the glyptal around the base with glyptal thinner and remove the defective lamp by unscrewing it from its socket. Screw the new lamp in place and apply a small amount of glyptal around the socket and base of the lamp.

4-14. A bayonet-type indicator lamp (I-102) is located on the front panel. (See figure 1-1.) After unscrewing the lens, remove the lamp by rotating it a quarter-turn counterclockwise. Insert a new lamp and secure in position by pressing down and rotating clockwise until the lamp base pins are engaged by the keyway on the socket. Replace the lens.

SECTION V

SPECIAL EQUIPMENT AND TOOLS

5-1. TEST EQUIPMENT REQUIRED.

5-2. Test equipment required to maintain, test, and calibrate FM Signal Generator Type 202-B is listed in table 5-1.

5-3. SPECIAL TOOLS REQUIRED.

5-4. No special tools are required for maintenance of the Type 202-B.

TABLE 5-1. TEST EQUIPMENT REQUIRED

Name	*Preferred Type or Required Characteristics*	*Alternate*	*Application*
Bolometer Bridge	Boonton Radio Corp.	Equivalent	Attenuator adjustment
Calibrator	Ferris Model 33-A	Equivalent	Frequency calibration
Distortion Analyzer	Hewlett-Packard Model 330-B	Equivalent	FM distortion measurements
Frequency Meter	TS-323/UR	—	Frequency calibration
Multimeter	TS-352/U	Navy OE Weston 790 Simpson 260	20,000 ohms-per-volt d-c voltage measurements, 1000 ohms-per-volt a-c measurements, resistance measurements
Headset	HS-33	Equivalent	General testing

TABLE 5-1. TEST EQUIPMENT REQUIRED (Cont.)

Name	*Preferred Type or Required Characteristics*	*Alternate*	*Application*
Linear FM Detector	Boonton Radio Corp.	Equivalent	AM percentage test
Oscilloscope	OS-8/U	Dumont 241	General use
Radio Receiver	Hallicrafters S-36A	Equivalent	FM deviation test
Signal Generator	TS-382A/U	Hewlett-Packard Type 200-C	Audio signal source
Tube Tester	Signal Corps Type I-177A	Hickock 540, 545, or 547	Vacuum tube testing
Vacuum Tube Voltmeter	ME-6A/U	Ballantine Model 300	A-c voltage measurements
Variable Transformer	General Radio Type 100R or 200 CM	American Transformer Corp. Model T14-5A	Input voltage control

SECTION VI

TROUBLE SHOOTING AND CORRECTION

6-1. PRELIMINARY INSPECTION.

6-2. Table 6-1 lists the inspections to be made of the Type 202-B to determine which parts require adjustment, repair, or replacement. Disassembly of the Type 202-B into its subassemblies is required for inspection (refer to paragraph 6-9). Before replacing any part which upon inspection indicates improper electrical operation or signs of overload, make a thorough electrical check of the circuit involved to determine if such defects are due to circuit troubles. Correct the trouble and replace the part or parts. Because of the critical placement of parts in the r-f unit, any replacement of a part necessitates recalibration of the unit. (Refer to paragraphs 8-9 through 8-25.) Replace all charred or poorly insulated wires. Resolder all broken or faulty connections. Replace defective locking or securing screws, washers, and nuts.

TABLE 6-1. PRELIMINARY INSPECTION CHART

WHAT TO INSPECT	*WHAT TO INSPECT FOR*	*REMEDIAL ACTION*
	Panel Assembly	
WIRING	Inspect all wiring for broken connections, frayed ends, shorts, or poor insulation.	Replace all defective wiring, using same length and color code as that removed.
RESISTORS, CAPACITORS, ETC.	Inspect for broken areas, charring, blistering, and other signs of overload.	Replace all defective detail parts.
TERMINAL AND SOLDER CONNECTIONS	Inspect all solder and terminal connections for loose or dirty connections.	Resolder loose terminal or solder connections. Remove all dirt or corrosion.
METERS	Inspect the meters for broken glass, broken or loose terminals, defective hermetic seals. Check that meter needle reads exactly zero.	Replace any meter exhibiting such defects. Tap meter *lightly*. If pointer does not move, replace meter.
KNOBS AND DIALS	Inspect the knobs and dials for cracks, breaks, or chips, and the dials for illegible or scored dial markings.	Replace broken or chipped knobs or dials with poor markings.

TABLE 6-1. PRELIMINARY INSPECTION CHART (Cont.)

WHAT TO INSPECT	*WHAT TO INSPECT FOR*	*REMEDIAL ACTION*
	Panel Assembly	
BINDING POSTS	Inspect binding posts for loose mounting base and broken threads.	Replace defective binding posts.
ROTARY SWITCHES	Check that terminals are secure and in place. Check that any detail parts mounted on the rotary switches are properly soldered.	Replace any rotary switch that has broken or loose terminals. If necessary to repair (by replacement of parts) the modulation frequency switch, S-104, replace only those detail parts which are easily accessible; otherwise replace the complete subassembly.
FUSE	Inspect and test fuse. Inspect fuse holder for defects.	Replace defective fuse F-101, or fuse holder E-117.
	R-F Assembly	
	CAUTION Unless trouble is localized to the r-f unit (refer to paragraph 6-20) the cover of the unit should not be removed for interior inspection. The inspections listed are external inspections.	
WIRING	Inspect all external wiring for broken connections, frayed ends, shorts, or poor insulation.	Replace all defective external wiring.
SEALS AND MECHANICAL STRUCTURE	Check that all sealed joints are secure, that shielding braid is in place, casting securely fastened, and can fit is snug.	Reseal defective seals with glyptal, resolder shielding braid if loose, and tighten all securing nuts.
	Audio Oscillator Assembly	
VACUUM TUBES	Remove each vacuum tube and inspect for loose or bent terminal pins, loose or cracked base. Test each tube in a tube tester for general condition and while under test, tap gently for indication of loose elements.	Replace any defective tube.
WIRING	Inspect wires for broken connections, frayed ends, shorts, or poor insulation.	Replace all defective wiring, using same length and color code. Resolder loose connections.
RESISTORS, CAPACITORS, AND CHOKES	Inspect resistors, capacitors and other detail parts for broken areas, charring, blistering, and other signs of overload or overheating.	Replace any defective part.

TABLE 6-1. PRELIMINARY INSPECTION CHART (Cont.)

WHAT TO INSPECT	*WHAT TO INSPECT FOR*	*REMEDIAL ACTION*
	Audio Oscillator Assembly	
SOCKETS	Inspect all sockets for faulty connections, broken terminals.	Replace defective sockets. Resolder loose connections.
CABLE	Inspect cable for loose connections, broken or faulty insulation. Check that cable is tied to upper mounting holes of chokes.	Replace any faulty wiring, using same gage, length, and color code, resolder loose connections, tie cable to upper mounting holes of chokes with string to prevent interference with other components in cabinet.
	Power Supply Assembly	
VACUUM TUBES	Remove each vacuum tube and inspect for loose or bent terminal pins, loose or cracked base. Test each tube in a tube tester for general condition and, while under test, tap gently for indication of loose elements.	Replace any defective tube.
TRANSFORMER	Check transformer for security of laminations. Inspect for insulation leakage, charring, or other signs of overheating. Inspect wiring for breaks or poor insulation.	Tighten lamination securing bolts. Replace transformer if overload has caused open or shorting windings. Repair any defective wiring.
RESISTORS, CAPACITORS, AND CHOKES	Inspect resistors, capacitors, and other detail parts for broken areas, open resistance windings, charring, blistering, and other signs of overloading or overheating.	Replace any defective part.
WIRING	Inspect wires for broken connections, frayed ends, shorts, or poor insulation.	Replace defective wiring using same gage, length and color code. Resolder loose connections.
SOCKETS	Inspect all sockets for faulty connections, broken terminals.	Replace defective sockets. Resolder loose connections.
CABLE	Inspect cable for loose connections, broken or faulty insulation. Check that cable is tied to upper mounting holes of chokes.	Replace any faulty wiring, resolder loose connections, tie cable to upper mounting holes of chokes with string to prevent interference with other components in cabinet.

6-3. TROUBLE SHOOTING.

6-4. Table 6-2 is a trouble-shooting chart which lists the symptoms of troubles which may be encountered with the Type 202-B, their probable causes, and suggested remedies.

TABLE 6-2. TROUBLE-SHOOTING CHART

Symptom	*Probable Cause*	*Remedy*
WITH EQUIPMENT CONNECTED TO A SUITABLE 115-VOLT SOURCE AND "POWER ON" SWITCH "ON," PANEL LAMP I-102 DOES NOT LIGHT	No primary a-c power	Check power source.
	Defective primary power cable connections	Check that P-101 is properly connected to the power source.
		Check that P-102 is securely connected to J-102 (inside cabinet).
	Defective primary power cable	Inspect the primary power cables and replace or repair if defective.
	Fuse F-101 defective	Replace F-101.
	Lamp I-102 open	Replace I-102.
	Primary winding or filament secondary winding of T-102 open or shorted	Check continuity of T-102. Replace if defective.
NOT ALL VACUUM TUBE FILAMENTS LIGHT	Defective vacuum tube	Remove unlighted vacuum tube(s) and test in Tube Tester I-177A for filament continuity.
	Filament ballast R-163 open	Replace R-163.
	T-102 filament winding open or shorted	Check T-102 filament winding for possible open or short and replace if proven defective.
F-101 BLOWS REPEATEDLY AS SOON AS POWER IS APPLIED OR F-101 BLOWS SOME TIME AFTER POWER IS APPLIED	V-107, C-145A, C-145B, C-145-C, C-135A, T-102 defective	Remove V-107. If with V-107 removed F-101 does not blow, check C-145A, C-145B, C-145C, and C-135A for possible short. If normal, test V-107 in tube tester. If V-107 tests good, check windings of T-102. Replace part proven defective.
FILAMENTS LIGHT BUT NO PLATE VOLTAGE	V-107 defective	Replace V-107.
	L-120 or L-121 open	Check continuity of L-120 and L-121. Replace if defective.
	C-145A, C-145B, or C-145C shorted	Check all parts and replace C-145 complete if any section is defective.
	Defective connection to terminal 3 of P-104 or X-111	Check terminal connections and continuity of wiring. See figure 9-4.
NO SCREEN VOLTAGE TO V-101, V-102, V-103, AND V-104—R-F UNIT INOPERATIVE	R-162 defective	Check R-162. Replace if defective.
	C-135A shorted	Check C-135A. Replace C-135 complete if section is defective.
	Defective connection to terminal 2 of P-104 or X-111	Check terminal connections and continuity of wiring. See figure 9-4.

Table 6-2. TROUBLE-SHOOTING CHART (Cont.)

Symptom	*Probable Cause*	*Remedy*
EQUIPMENT OPERATES NORMALLY ON 54—108 MC RANGE ONLY	S-101 or S-102 defective	Replace S-101 or S-102. Refer to paragraph 6-16J.
NO MODULATION METER OR R-F OUTPUT METER READINGS —EQUIPMENT INOPERATIVE	Audio oscillator assembly defective	Remove and test all vacuum tubes. Measure voltages and resistances at tube socket terminals. (See figures 9-5 and 9-6.) Check all detail parts for possible defects. Replace defective parts.
	Power supply defective	Remove and test all vacuum tubes. Measure voltages and resistances at tube socket terminals. (See figures 9-5 and 9-6.) Check all detail parts for possible defects. Replace defective parts.
	Panel assembly parts defective	Check all detail parts. Inspect all wiring for opens, shorts, or loose connections. Look for blistering, charring, or other signs of overheated parts. Replace defective parts. See figure 9-2.
	R-f assembly defective	Remove and test all vacuum tubes in Tube Tester I-177A. Measure voltages and resistances at tube socket terminals (refer to figures 9-5 and 9-6.) Recalibrate unit. Refer to paragraphs 8-9 through 8-25.
NO R-F OUTPUT. NO R-F MONITOR METER READING. MODULATION METER READS	R-f assembly possibly defective	Check V-101, V-102, V-103, and V-104 in r-f unit. (Refer to paragraph 4-7.) Check r-f meter M-101, S-102, R-150, R-151, and R-152. Replace defective parts. Recalibrate and adjust r-f unit. Refer to paragraphs 8-9 through 8-25.
NO MODULATION METER READING. NORMAL R-F OUTPUT AND R-F MONITOR METER READING	Defective M-102	Tap meter case gently to see if needle is frozen. Check meter connections. Replace meter if proven defective.
	R-f assembly possibly defective	Check S-106, R-145, R-146, C-146, R-142. Replace defective parts.

6-5. REPAIR OF ELECTRONIC COMPONENTS

6-6. GENERAL. The corrective actions suggested to eliminate the possible troubles listed in Table 6-2 are self-explanatory with the following exceptions: The modulation frequency switch, S-104, except for easily accessible parts, is not subject to practical repair and therefore should be replaced as a complete assembly. Repair and replacement procedures for S-104 are outlined in paragraphs 6-23 through 6-26.

6-7. In other instances where repair of electronic components is required, standard maintenance procedures are to be employed. Such repair will include soldering of loose or open connections, replacement of meters, vacuum tubes, capacitors and resistors, testing for wire continuity, possible shorts, etc. Figures 6-1 through 6-7A are views of the major assemblies, designed to aid in the location of detailed parts. Reference to these illustrations and also of the schematic diagram, figure 9-1, the wiring diagrams, figures 9-1A, 9-2, 9-3 and 9-4, the terminal voltage diagram, figure 9-5, and the terminal resistance diagram, figure 9-6, will facilitate maintenance of the equipment.

6-8. Disassembly of the Type 202-B into its subassemblies is described in paragraphs 6-10, 6-12, 6-14, and 6-16. Reassembly is described in paragraphs 6-11, 6-13, 6-15, and 6-17.

6-9. REMOVAL AND REPLACEMENT OF SUBASSEMBLIES.

6-10. REMOVAL OF PANEL ASSEMBLY.

a. Unscrew and remove the ten No. 8-32 springer-type Phillips screws on the outer edges of the front panel.

b. Grasp the outer edges of the front panel and pull the panel forward as far as the connecting cables will permit.

c. Support the panel assembly in an upright position, reach behind the front panel and disconnect the power supply cable connector P-104 from X-111 on the right side of the panel, the a-c input cable connector P-102 from J-102 located at the right-front-inner corner of the cabinet base, and the audio oscillator cable connector P-103 from X-110 on the left side of the panel.

d. Remove the panel assembly and the attached r-f assembly from the cabinet.

CAUTION

Before placing this assembly outside the working area, retract the attenuator rack and pinion by rotating the front-panel "MICROVOLTS" control.

6-11. REPLACEMENT OF PANEL ASSEMBLY.

a. Stand the cabinet on its base and support the panel assembly in an upright position, with its rear section in proximity to the cabinet opening.

b. Connect the audio oscillator cable connector P-103 to the 11-contact connector X-110 on the left-rear side of the panel; the a-c input cable connector P-102 to J-102, which is located at the right-front-inner corner of the cabinet base and the power supply cable connector P-104 to the octal connector X-111 on the right-rear side of the panel.

c. Insert the panel within the cabinet and stand the equipment on its back. Secure the panel assembly with the ten No. 8-32 Phillips screws and tighten.

6-12. REMOVAL OF AUDIO OSCILLATOR ASSEMBLY.

a. Remove the panel assembly as described in paragraph 6-10.

b. Stand the cabinet on its back.

c. Hold the audio oscillator assembly firmly and remove from the outer surface of the cabinet base the four binding-head screws and lockwashers which secure the assembly. Remove the assembly.

6-13. REPLACEMENT OF AUDIO OSCILLATOR ASSEMBLY.

a. Stand the cabinet on its back.

b. Place the audio oscillator assembly on the left-inner side of the cabinet base, with its connecting cable nearest the cabinet opening.

c. Secure in position with four binding-head screws and lockwashers. Tighten all screws.

d. Replace the panel assembly as described in paragraph 6-11.

6-14. REMOVAL OF POWER SUPPLY ASSEMBLY. The procedure for removal of the power supply assembly is identical to that used for the audio oscillator assembly. Refer to paragraph 6-12.

6-15. REPLACEMENT OF POWER SUPPLY ASSEMBLY. To replace the power supply, follow the procedure outlined for replacement of the audio oscillator assembly (refer to paragraph 6-13) except secure the power supply to the right-inner side of the cabinet base.

6-16. REMOVAL OF R-F ASSEMBLY Z-101. (See figure 6-1.)

CAUTION

Do not detach the r-f assembly from the panel assembly unless replacement by a new assembly is required. Removal and replacement should take place only after exhaustive tests have proven the r-f assembly to be defective. Refer to paragraph 6-20.

a. Remove the panel assembly from the cabinet. Refer to paragraph 6-10.

b. Support the panel assembly in an upright position.

Note

It is suggested that a gusset plate be fabricated which can be attached temporarily to either the left or the right side of the panel. Alternate means of support are blocks under each corner with the panel assembly resting on the attached r-f assembly.

c. Remove knob E-109 by unscrewing slotted-head set screw. Loosen the deviation range switch S-103 by turning the hexagonal mounting nut a half-turn.

d. Remove knob E-112 with a No. 8 Allen wrench.

e. Remove the fiducial I-107 over the main frequency dial I-104 by removing the two securing screws. Remove main frequency dial I-104 by loosening the two No. 10 Allen set screws.

f. Remove knob E-110 by unscrewing slotted-head set screw.

g. Remove attenuator dial I-106 with a No. 10 Allen wrench.

h. Loosen fiducial bearing plate A-103, which supports the r-f attenuator shaft, by untightening by one turn each of the two No. 6 screws that clamp this assembly to the front panel.

i. Remove the "RF OUTPUT" connector J-101 from the front panel by removing the four No. 3-56 screws.

j. Cut the string (rear of panel) tying the RG-58/U attenuator cable to the primary power cable W-103.

k. Remove the power supply octal socket, X-111, with attached cable wiring, from its mounting studs by removing the two No. 6-32 screws.

l. Unsolder the brown heater wire connected to terminal 5 of X-111.

m. Unsolder the red-white lead from the r-f assembly connected to terminal 2 of X-111.

Note

Not the red-white lead from the main cable.

n. Unsolder the yellow lead connected to the positive side of the r-f monitor meter M-101.

o. Unsolder the orange lead connected to the arm (middle terminal) of the r-f monitor control potentiometer R-161.

p. Unsolder the green-white lead from the terminal at the lower side of R-153, located on terminal board E-101.

q. Remove the three No. 10 Phillips screws (front of panel) which mount the spacer studs of the r-f assembly to the front panel: one adjacent to the "54-108" panel engraving, one diagonally opposite to the right (this screw was exposed with the removal of the "FREQUENCY MC" dial), and one adjacent to E-117.

r. Lift the r-f assembly free of front panel.

CAUTION

Hold the assembly securely to avoid damage while removing from front panel.

6-16A. DISMANTLING AND DISASSEMBLY OF R-F ASSEMBLY Z-101.

Note

Do not dismantle or disassemble the r-f assembly further than is necessary for the repair or replacement of a specific part.

6-16B. REMOVAL OF R-F ASSEMBLY COVER A-111. (See figure 6-2.) To remove the cover of the r-f assembly, proceed as follows:

a. Apply glyptal thinner to the cover seals.

b. Remove six nuts H-145 and three lockwashers H-155.

c. Slide the three holding plates A-110 from the threaded studs.

d. Tap the cover A-111 gently with the palm of the hand and remove.

6-16C. REMOVAL OF THE ATTENUATOR ASSEMBLY Z-106. (See figure 6-2.) To remove the attenuator assembly from the r-f assembly, use the following procedure:

a. Using a #6 hexagon wrench, remove the cap screws H-143 and H-144.

b. Carefully slide attenuator tube out of the r-f assembly.

6-16D. DISASSEMBLY OF THE ATTENUATOR ASSEMBLY Z-106. (See figure 6-2A.) To disassemble the attenuator assembly, proceed as outlined below:

a. Loosen set screws H-159 on gear O-132, collar O-128, and spacer O-130, using a #6 hexagon wrench.

b. Work the shaft O-136 through support A-118, taking off washers H-161 and H-162, collar O-130, spacer O-128, plate O-131, washer H-161, gear O-132, two springs O-141, and gear O-138, with hub O-133. If necessary the hub O-133 may be removed from the shaft of gear O-138 by driving out the pin H-170.

c. Remove three screws H-154, and three washers H-155 from rack bearing plate A-117, which will free rack and piston assembly.

d. Slide bearing plate A-117 along cable assembly W-106 and remove rack O-137 and cable assembly W-106 from support A-118.

e. Unsolder the bent lead of resistor R-118, and apply polyethylene thinner to loosen the resistor.

f. Unscrew resistor retainer O-134 and withdraw it from O-137, along with R-118, O-135, and W-106.

g. Unsolder the cable shield from the retainer body and the other resistor lead from the cable center conductor. This will free the piston O-135.

6-16E. REMOVAL OF CASTING A-109. (See figure 6-2.) To remove the casting A-109 from the r-f assembly, remove the nine screws H-147 from the shield-cover-side lower tier of the casting and the two hex head screws H-148 which are screwed through the mounting plate A-131. Lift the casting off the mounting plate A-131.

6-16F. REMOVAL OF GEAR ASSEMBLY O-124. (See figure 6-2.) To remove the gear assembly O-124, loosen set screws H-149 on gear O-129 and collar O-125, and remove the gear and collar. Slide washer H-150 along the shaft, remove the hex nut H-151, and take off washer H-146. Remove the gear assembly.

6-16G. REMOVAL AND DISASSEMBLY OF THE RANGE SWITCH ASSEMBLY Z-108. (See figure 6-2.) The range switch assembly Z-108 consists of S-101 and S-102. To remove and disassemble Z-108, proceed as follows:

a. Tag and unsolder all connecting wires. With the aid of a 9/16-inch open-end wrench applied to the post A-116, unscrew Z-108 from plate A-131.

b. Loosen set screw H-149 with a #6 hexagon wrench and remove gear O-126.

c. Remove nut H-152, washer H-107, and pull out switch S-102 from plate A-112.

d. Remove two screws H-167, two lockwashers H-166, two plates A-130, and washer H-162 from end of shaft O-140.

e. Pull out shaft O-140 with gear O-127 attached, and remove washer H-164.

f. Remove gear O-127 from shaft O-140 with gear puller.

g. Remove nut H-152, washer H-107 and separate post A-116 from plate A-112.

6-16H. REMOVAL OF R-F MONITOR METER POTENTIOMETERS R-150 AND R-152. (See figure 6-2.) To remove potentiometers R-150 and R-152 unscrew two screws H-165 and remove the mounting bracket A-113, with R-150 and R-152, from plate A-131. To remove either potentiometer from the mounting bracket remove the securing hexagon nut and locknut.

6-16J. REMOVAL OF R-F FILTER ASSEMBLY Z-105. (See figure 6-2.) To remove the r-f filter assembly, remove the screw H-154 and the clamp H-163 to free the connecting wires. Remove the hexagon nut H-156 and lockwasher H-157, and lift out Z-105.

6-16K. DISASSEMBLY OF R-F FILTER ASSEMBLY Z-105. (See figure 6-2B.) To disassemble the r-f filter assembly Z-105, proceed as follows:

Note

In the disassembly of the r-f filter assembly, the resistors and chokes contained therein will be freed when the connecting leads are unsoldered from the disc-mounted capacitors. If it is desired to remove the capacitors, it will be necessary to unsolder the tabs which are bent over the bottom edge of the mounting holes.

a. Unscrew two screws H-169 and remove shield A-125.

b. Remove screw H-168 and lockwasher H-102 which secure O-139 to post A-124.

c. Unsolder connections to terminal disc O-139 and remove O-139.

d. Unscrew post A-124. Unsolder connections to capacitors mounted in disc A-119, and remove disc A-119.

e. Unscrew mounting post A-122. Unsolder connections to capacitors mounted in disc A-120, and remove disc A-120.

f. Unsolder connections to capacitors mounted in disc A-121.

g. Remove screw H-168 and lockwasher H-102 to separate and disc A-121 from post A-123.

6-16L. REMOVAL OF MODULATOR POTENTIOMETERS R-105 and R-108. (See figure 6-2.) To remove modulator potentiometers R-105 and R-108, proceed as follows:

a. Unsolder connections to R-105 and R-108.

b. Remove screw H-158 and lockwasher H-102. Lift off R-105 and R-108 attached to A-114, and remove the other lockwasher H-102 and post A-115.

c. To separate either potentiometer R-105 from plate A-114, remove hexagon nut and washer.

6-16M. REMOVAL OF R-F TUNING UNIT Z-107. (See figure 6-2.) To remove the r-f tuning unit Z-107, proceed as follows:

a. Remove hexagon nut H-126 and lockwasher H-102 from plate A-131.

b. Remove two screws H-154 and lockwashers H-155 from plate A-131. If not previously removed, as outlined in paragraph 6-16J, remove another screw H-154 and lockwasher H-155 which also holds the cable clamp H-163.

c. Remove r-f tuning unit Z-107 from plate A-131.

6-16N. REASSEMBLY OF R-F ASSEMBLY Z-101.

6-16P. Reassembly of the subassemblies of r-f assembly Z-101, and the assembly of all subassemblies into a complete unit, may be accomplished by reversing the procedures outlined in paragraphs 6-16B through 6-16M.

CAUTION

With attenuator assembly assembled and rack O-137 fully retracted, pickup loop formed by lead of R-118 should extend approximately 1/16-inch outside of tube A-118.

6-17. REPLACEMENT OF R-F ASSEMBLY Z-101. (See figure 6-1.)

a. Position the r-f assembly with the attenuator tube down and engage the attenuator drive shaft in the bearing hole of the attenuator fiducial plate A-103. Insert the frequency dial shaft and the r-f range switch shaft into their respective panel holes.

b. Bring the r-f assembly mounting stud with shoulder into its locating hole in the front panel and secure all three mounting studs loosely to the panel with the No. 10 Phillips screws to permit proper mechanical alignment of the r-f assembly. Position the assembly so that the shafts do not rub against the sides of the panel clearance holes.

c. Adjust the gear train lock under the deviation range switch S-103, so that the locating shoulder on the top corner of the gear train frame rides freely in the gear train lock when the frequency dial I-104 is rotated from its extreme clockwise position to the full counterclockwise position.

d. Tighten the hexagonal mounting nut of the deviation range switch S-103, making certain that the terminals of the switch are not contacting the metal gear train frame.

e. Position the braided shield cable near S-103 so that it does not interfere with the gear train. This cable should be located between the deviation range switch wafer, S-103, and the gear train lock to have ample clearance with the vernier frequency dial (controlled by the knob E-112.)

f. Align the attenuator fiducial bearing plate A-103 to permit free rotation of the attenuator shaft; then tighten the two No. 6 securing screws.

g. Secure the "RF OUTPUT" connector J-101 to the panel with four No. 3-56 screws. The RG-58/U cable should be dressed away from the attenuator, looping back toward the r-f assembly on the audio frequency range switch side (S-104) of the attenuator and passing between the attenuator shaft and the r-f assembly mounting stud, thence under the power cable W-103 above its clamp to J-101 on the panel. (See figure 6-7.) Lace the attenuator cable to the power cable below the cable clamp, making certain that the cable runs freely in and out of the attenuator as the rack position is changed. (See figure 6-7.)

h. Solder the red-white 150-volt lead from the r-f assembly to terminal 2 of X-111, the power assembly mating connector.

i. Solder the brown heater wire from the r-f assembly to terminal 5 of X-111.

j. Solder the yellow lead from the r-f assembly to the positive terminal (left) of the r-f monitor meter M-101.

k. Solder the orange lead (supplying screen voltage for the final r-f assembly stage) to the middle terminal of the r-f monitor control potentiometer R-161.

l. Solder the green-white lead from the r-f assembly to the solder terminal at the lower side of R-153 on the terminal board E-101.

m. Replace and secure X-111 by refastening it to the panel spacers with two No. 6 screws and lockwashers.

n. Replace the deviation range switch knob E-109, by tightening its set screw, so that the arrow on the knob will point directly to "24", "80", or "240" as the switch is turned through its three positions.

o. Replace vernier frequency knob E-112 by tightening the two No. 8 Allen set screws.

p. Replace the main frequency dial I-104 and tighten one of its No. 10 Allen set screws. Turn the knob counterclockwise to the stop. Replace the engraved fiducial I-107 over the frequency dial by mounting it above the frequency dial and securing with the two aluminum spacers and the two No. 4-36 screws. Loosen the set screw in the main frequency dial I-104, turning the dial until the "54" mc line is reached on the outer scale. Adjust the position of the fiducial, so that the hairline crosses both the "54" mc line on the outer scale and the corresponding "108" mc line on the inner black scale. Tighten the fiducial mounting screws and both No. 10 Allen set screws in the main frequency dial after rechecking the alignment. Turn the vernier frequency dial knob E-112 counterclockwise to the stop and then turn clockwise to the *nearest zero* before proceeding further. Loosen the No. 10 Allen set screws in the main frequency dial knob. Hold the vernier dial in the zero position above and slip the main frequency dial on its shaft until the zero on the red scale of the main frequency dial is directly under the fiducial hairline; re-tighten the No. 10 Allen set screws. The main frequency dial is now in exact register, so as to properly indicate the output frequency of the Type 202-B.

q. Replace the r-f range switch knob E-110 by tightening the No. 6-32 set screw to the shaft flat.

r. Replace the attenuator dial I-106 by tightening one of the two No. 10 Allen set screws and turn the knob clockwise to the stop. Loosen the set screws again and slip the knob, without turning the shaft, until the "2" calibration line directly to the right of ".1" marking is opposite the fiducial line above; tighten both No. 10 Allen set screws. When the knob is turned clockwise to the stop, the dial reading will be precisely 0.2 volt. The attenuator dial now indicates the r-f output voltage directly in microvolts.

s. Perform alignment and recalibration described in paragraphs 8-10A through 8-10J. Then perform adjustments outlined in paragraph 6-18.

6-18. R-F ASSEMBLY ADJUSTMENTS AFTER REPLACEMENT.

6-19. The following tests and adjustments should be performed after replacing the r-f assembly.

a. With the equipment assemblies removed from the cabinet but interconnected, and with the equipment connected to a nominal 117-volt 50- to 60-cycle a-c power source, apply power to the equipment and allow it to warm up for a minimum period of 30 minutes.

b. With Multimeter TS-352/U, measure the d-c voltage from ground to terminal 2 of X-111, the terminating point for the red wire with white tracer from the r-f assembly. A reading between 143 and 157 volts d-c should be obtained.

c. With the ME-6A/U voltmeter, measure the a-c voltage from ground to terminal 5 of X-111, the terminating point for the brown wire from the r-f assembly. The voltage should be between 6.3 and 7.3 volts a-c.

d. Set the "RF RANGE" switch on "54-108", the "FREQUENCY MC" dial at 60 mc, the "INT MOD" switch on "AM," the "MODULATION METER" switch to "AM," the "FREQ CPS" dial to "400" cps, the "MICROVOLTS" dial at 0.1 microvolt, the "AM" control for a modulation meter reading of "50%", and the "RF" control adjusted to set the r-f monitor meter M-101 to the red line.

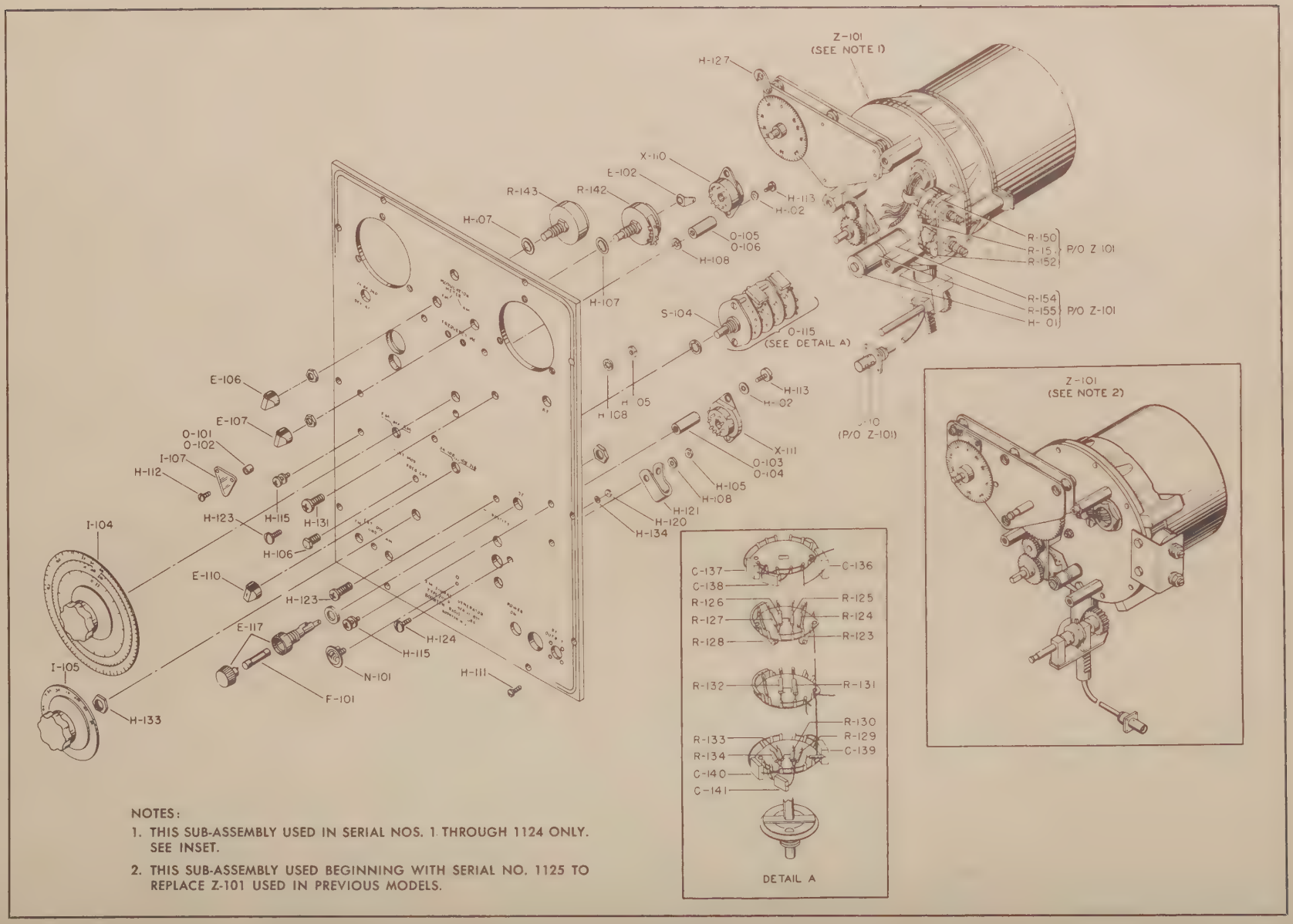
e. Using the ME-6A/U voltmeter, connected between the "AM" binding post and the "GND" binding post, reset the audio voltage by adjusting R-136 on the audio oscillator chassis with a screwdriver to a value indicated as condition III on the installation tag of the r-f assembly. See figure 6-8.

f. With the control settings of step d., and using Multimeter TS-352/U and the ME-6A/U voltmeter, make the following adjustments. Connect Multimeter TS-352/U (adjusted for a d-c voltage reading on the 250-volt range) and the ME-6A/U voltmeter in parallel from ground to the center terminal of the "RF" potentiometer R-161, the terminating point for the orange wire from the r-f assembly. Vary R-161 until the d-c voltage is identical to that given on the r-f assembly installation tag as condition IV (volts d-c). (See figure 6-8.) Then vary R-142, the "AM" potentiometer, until the a-c voltage read on the ME-6A/U voltmeter is identical to that given on the r-f assembly installation tag as condition IV (volts a-c). With R-161 and R-142 remaining in these positions, adjust R-145, the modulation meter calibration potentiometer, mounted on the terminal board E-101 (O-120 in models beginning with serial number 1125) until M-102, the modulation meter, reads exactly "50%".

g. Set the "RF RANGE" switch on "54-108," the "FREQUENCY MC" dial at 60 mc, the "INT MOD" switch to "FM", the "MODULATION METER" switch to "FM", the "FREQ CPS" dial to "400" cps, the "MICROVOLTS" dial to 0.1 uv, the r-f monitor meter set to the red line, and the "DEV KC" control to "80".

h. Using the ME-6A/U voltmeter, measure the a-c voltage from ground to the terminal point of R-153, at which the green wire with white tracer from the r-f assembly is connected. (This terminal is closest to the r-f assembly.) By means of R-143, the "FM" potentiometer on the front panel, adjust this voltage to that specified on the r-f assembly installation tag as condition V. Vary the setting of R-146, which is mounted on E-101 (O-120 in models beginning with serial number 1125) until the modulation meter reads precisely 70 kc on the 80-kc deviation range. Seal R-146 with glyptal.

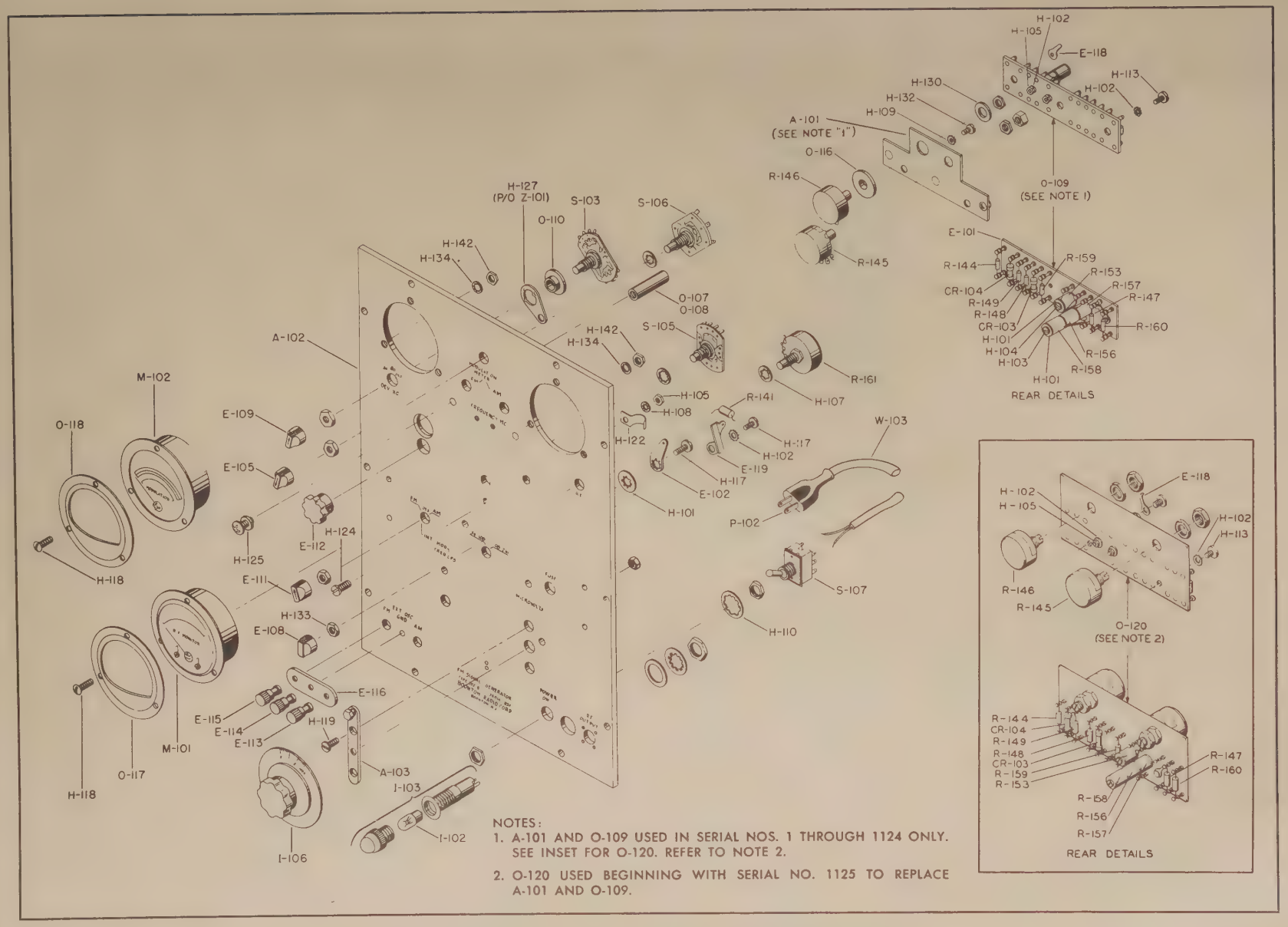
i. Check the frequency calibration. Refer to paragraph 8-11.



NOTES:

1. THIS SUB-ASSEMBLY USED IN SERIAL NOS. 1 THROUGH 1124 ONLY. SEE INSET.
2. THIS SUB-ASSEMBLY USED BEGINNING WITH SERIAL NO. 1125 TO REPLACE Z-101 USED IN PREVIOUS MODELS.

Figure 6-1. Panel Assembly, Exploded View (Sheet 1 of 2)



NOTES:
1. A-101 AND O-109 USED IN SERIAL NOS. 1 THROUGH 1124 ONLY. SEE INSET FOR O-120. REFER TO NOTE 2.
2. O-120 USED BEGINNING WITH SERIAL NO. 1125 TO REPLACE A-101 AND O-109.

Figure 6-1. Panel Assembly, Exploded View (Sheet 2 of 2)

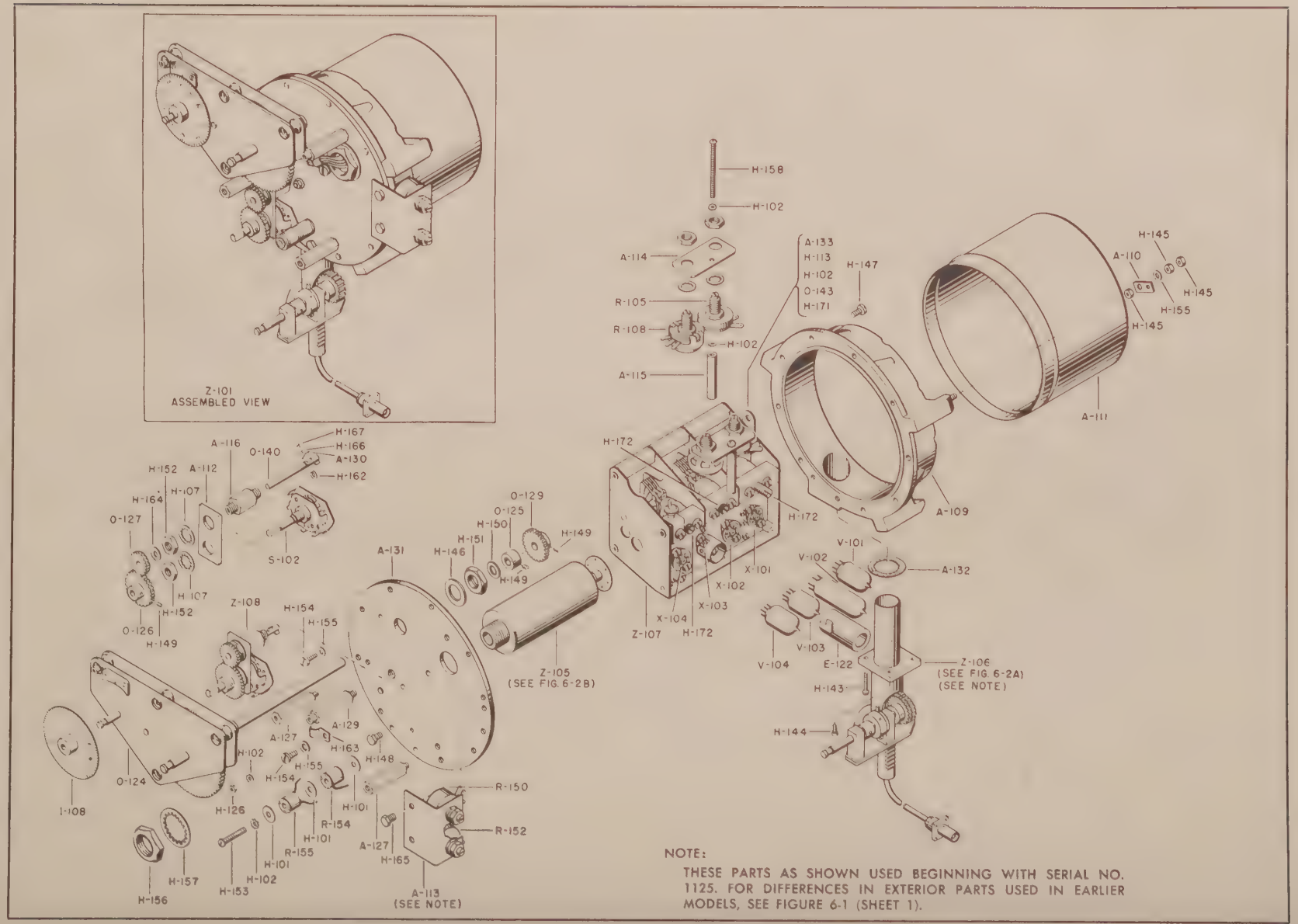


Figure 6-2. R-F Assembly Z-101, Exploded View

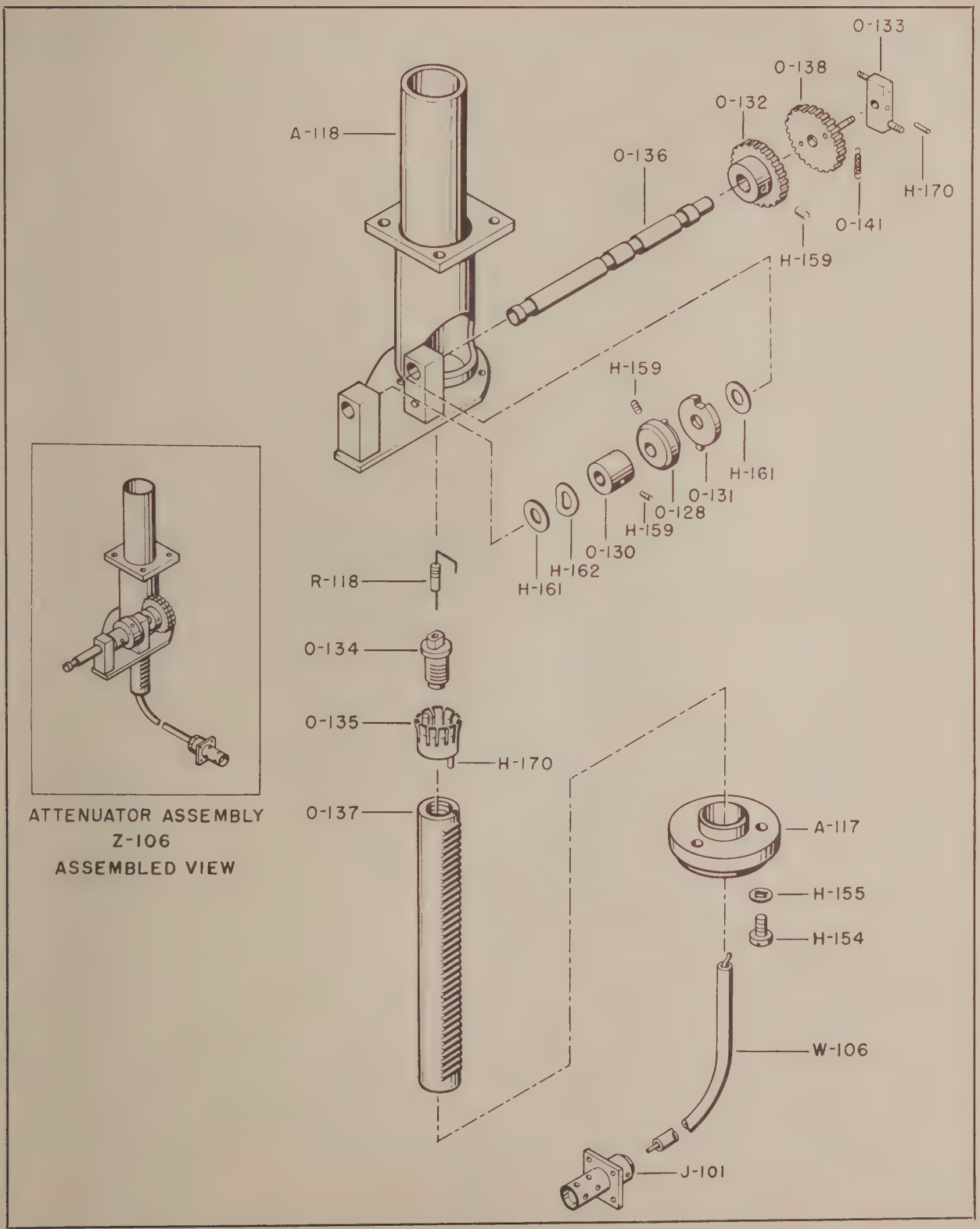


Figure 6-2A. Attenuator Assembly Z-106, Exploded View

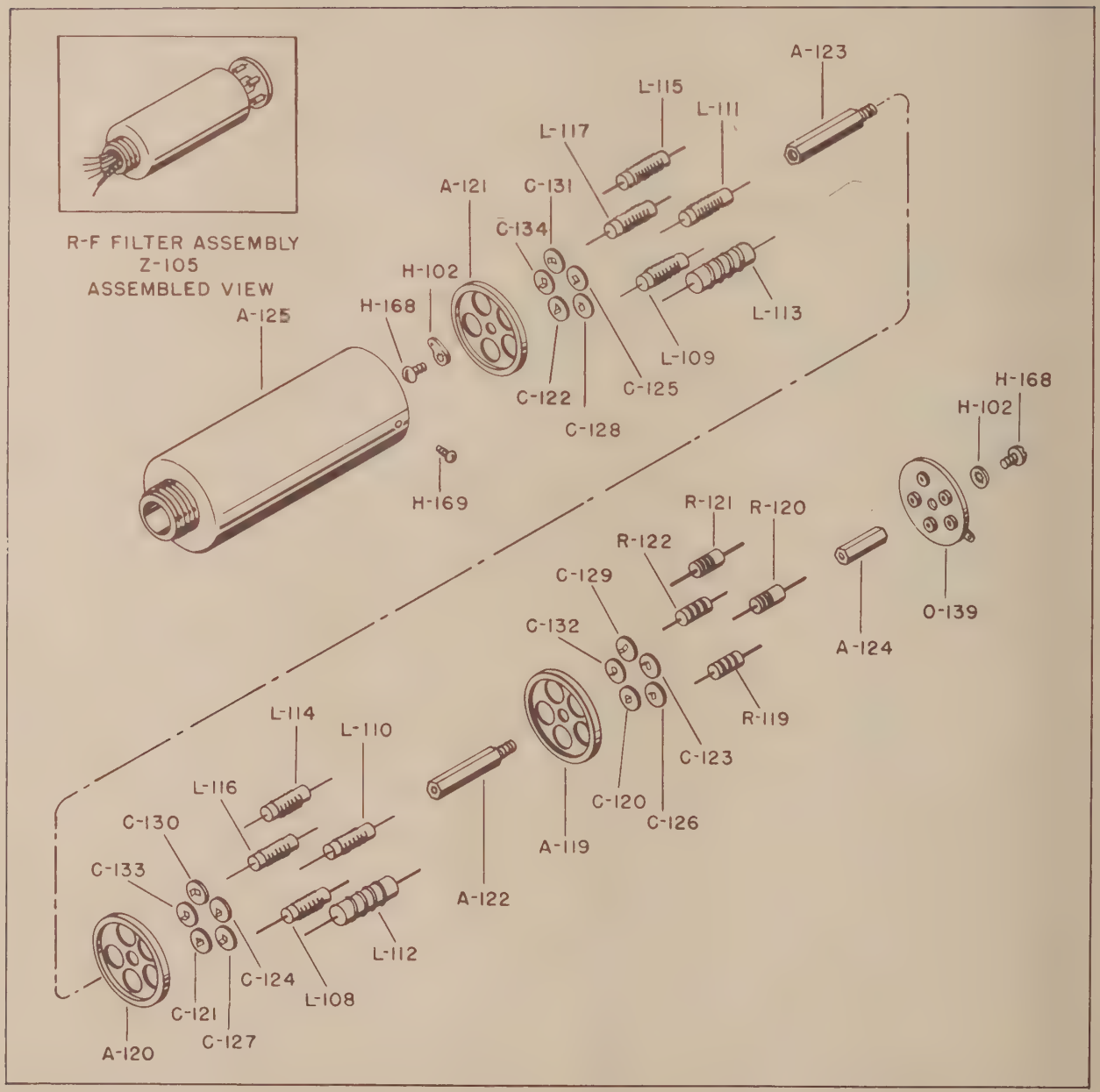
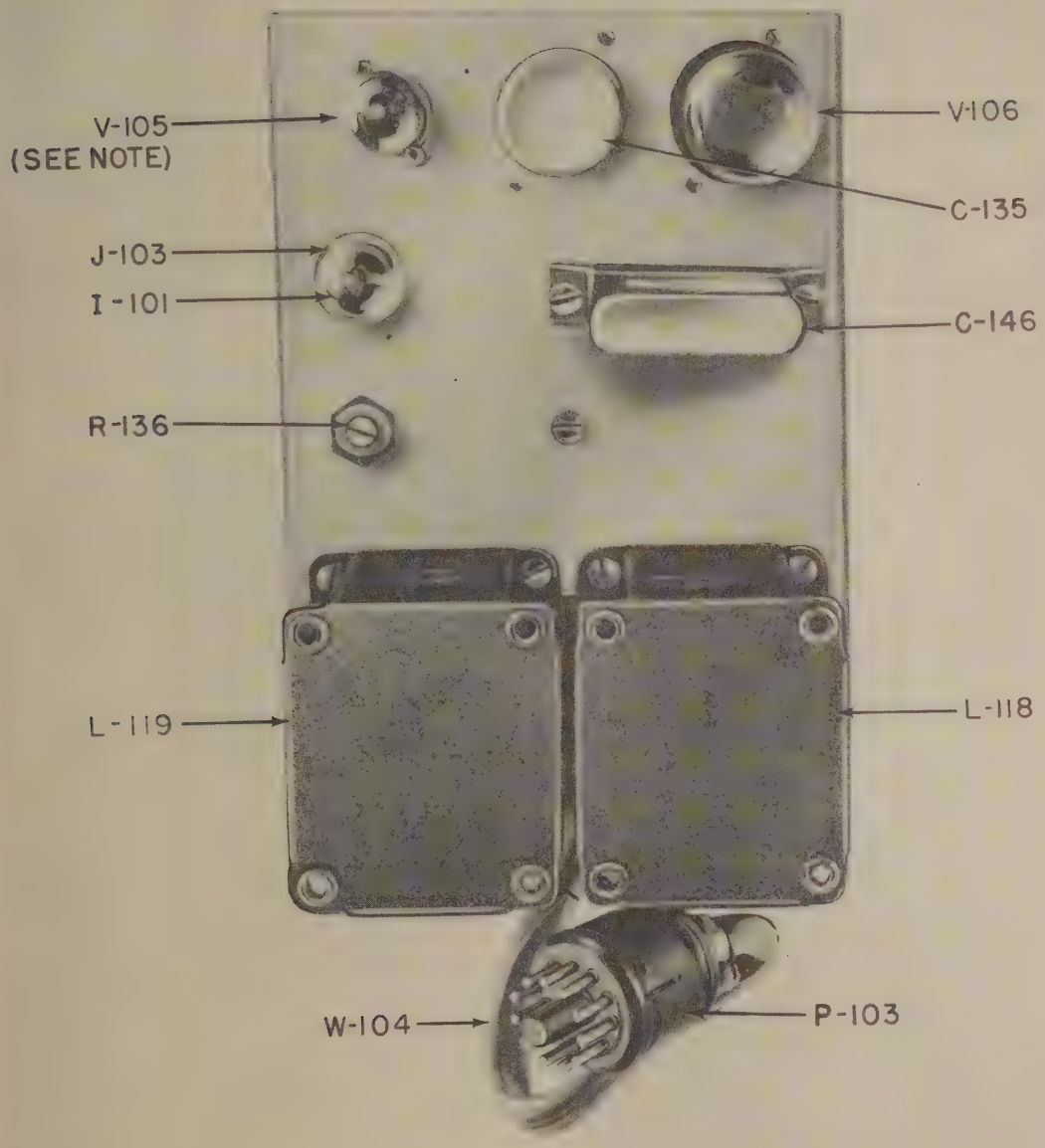


Figure 6-2B. R-F Filter Assembly Z-105, Exploded View



NOTE:
V-105 IS A TYPE 6J5 IN SERIAL NO. 1-1124. BEGINNING WITH SERIAL NO. 1125 A TYPE 6AU6 (SHOWN) IS USED.

Figure 6-3. Audio Oscillator Assembly, Top View

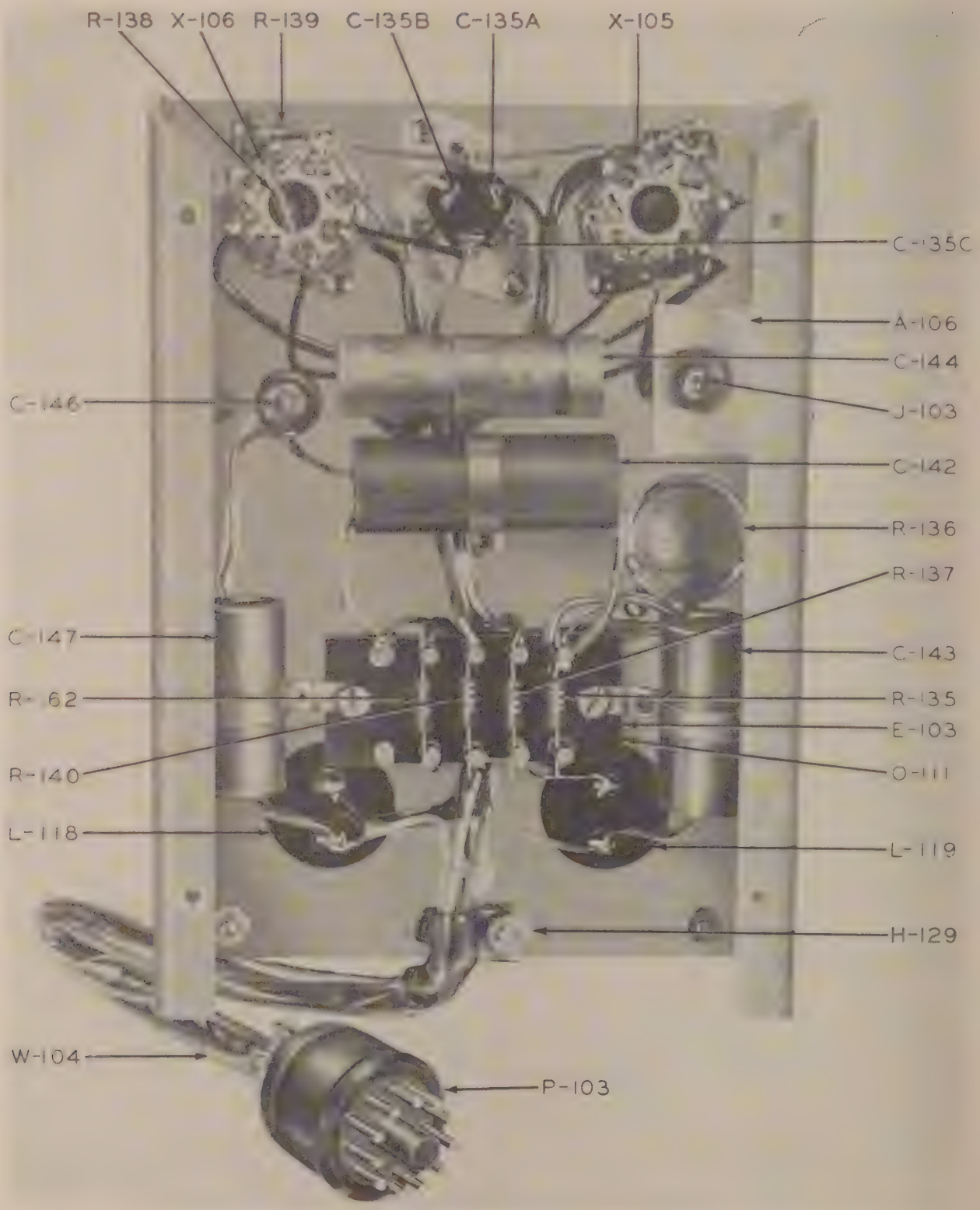


Figure 6-4. Audio Oscillator Assembly, Bottom View (Serial No. 1-1124)

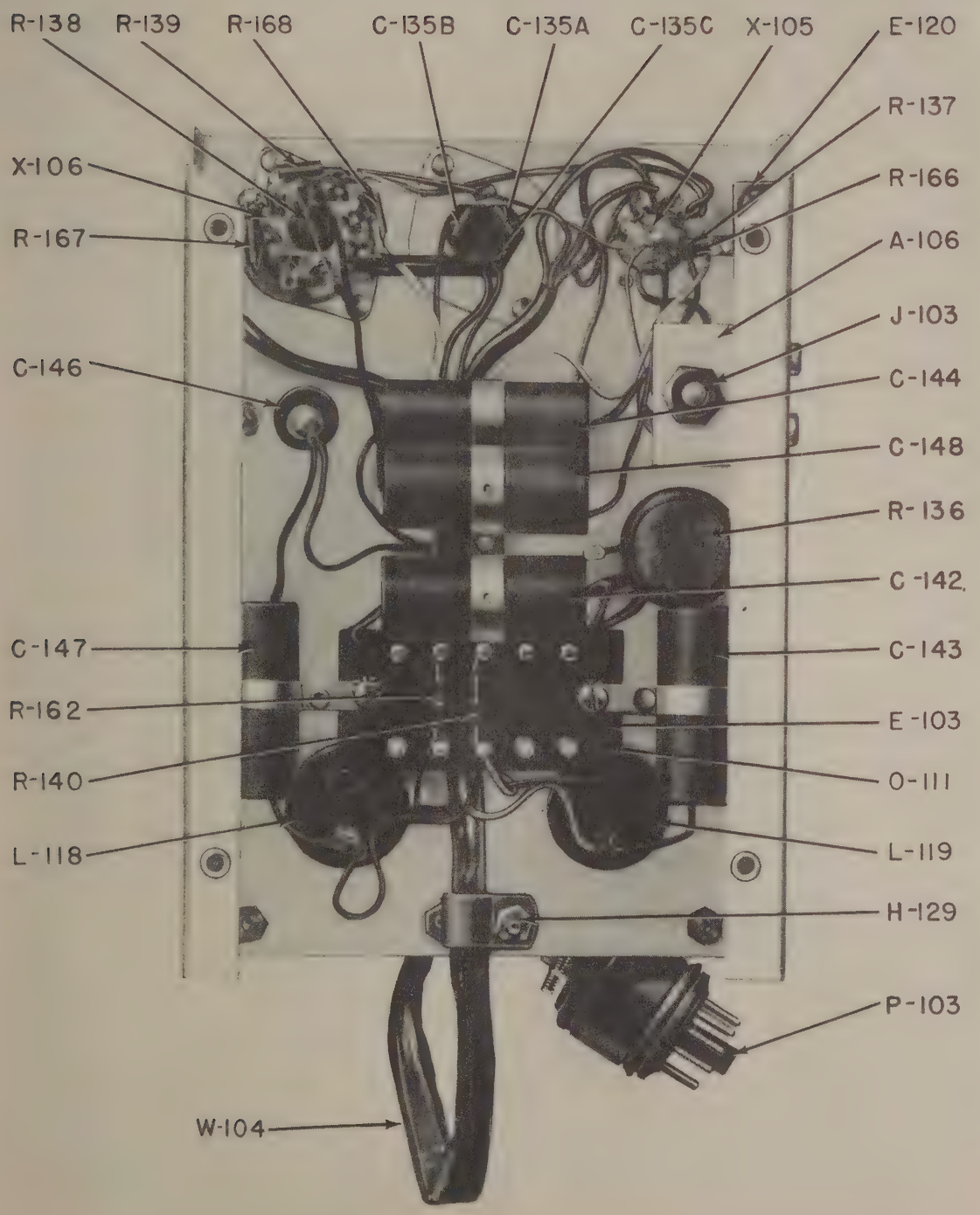


Figure 6-4A. Audio Oscillator Assembly, Bottom View (Serial No. 1125 and Following)

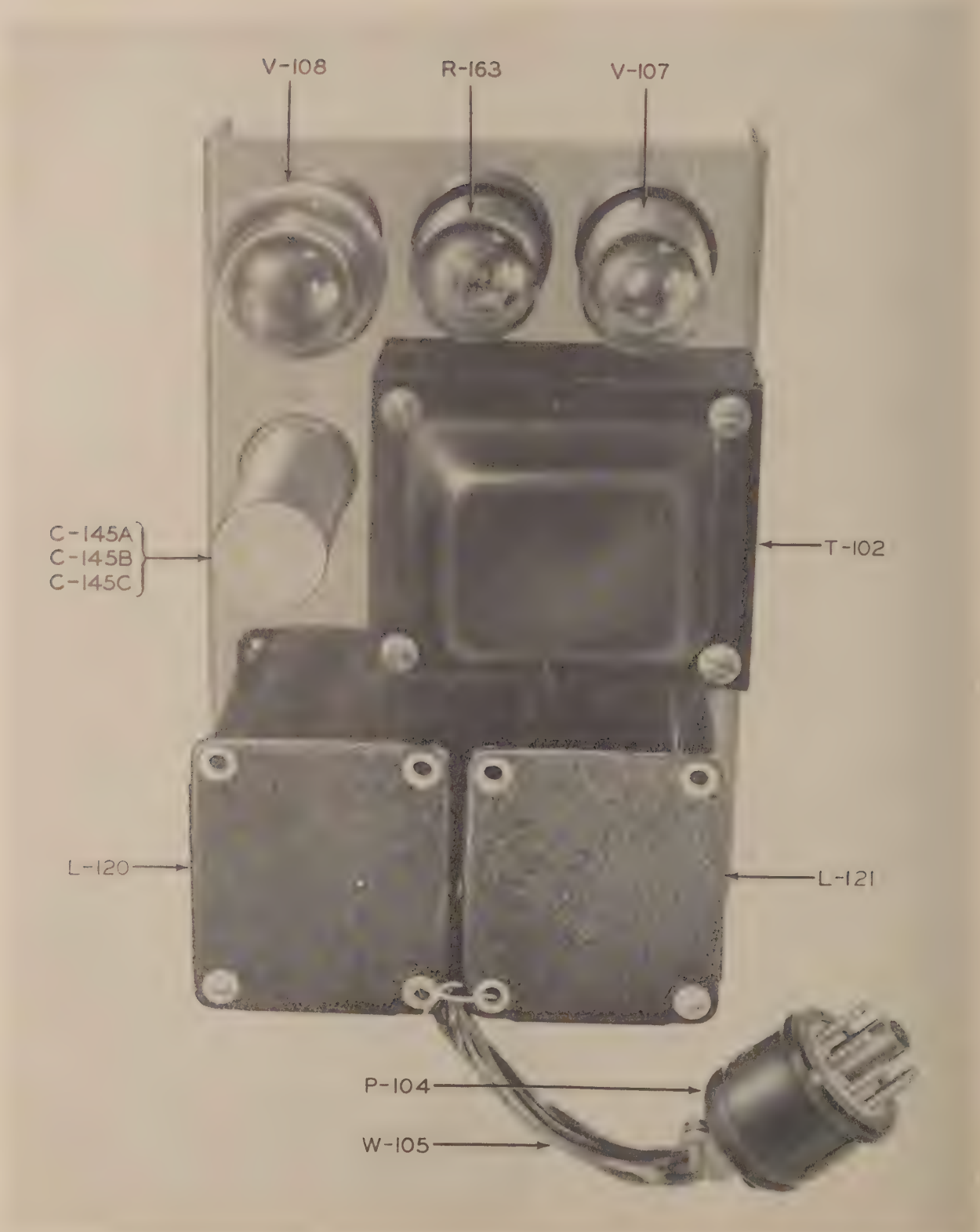


Figure 6-5. Power Supply, Top View

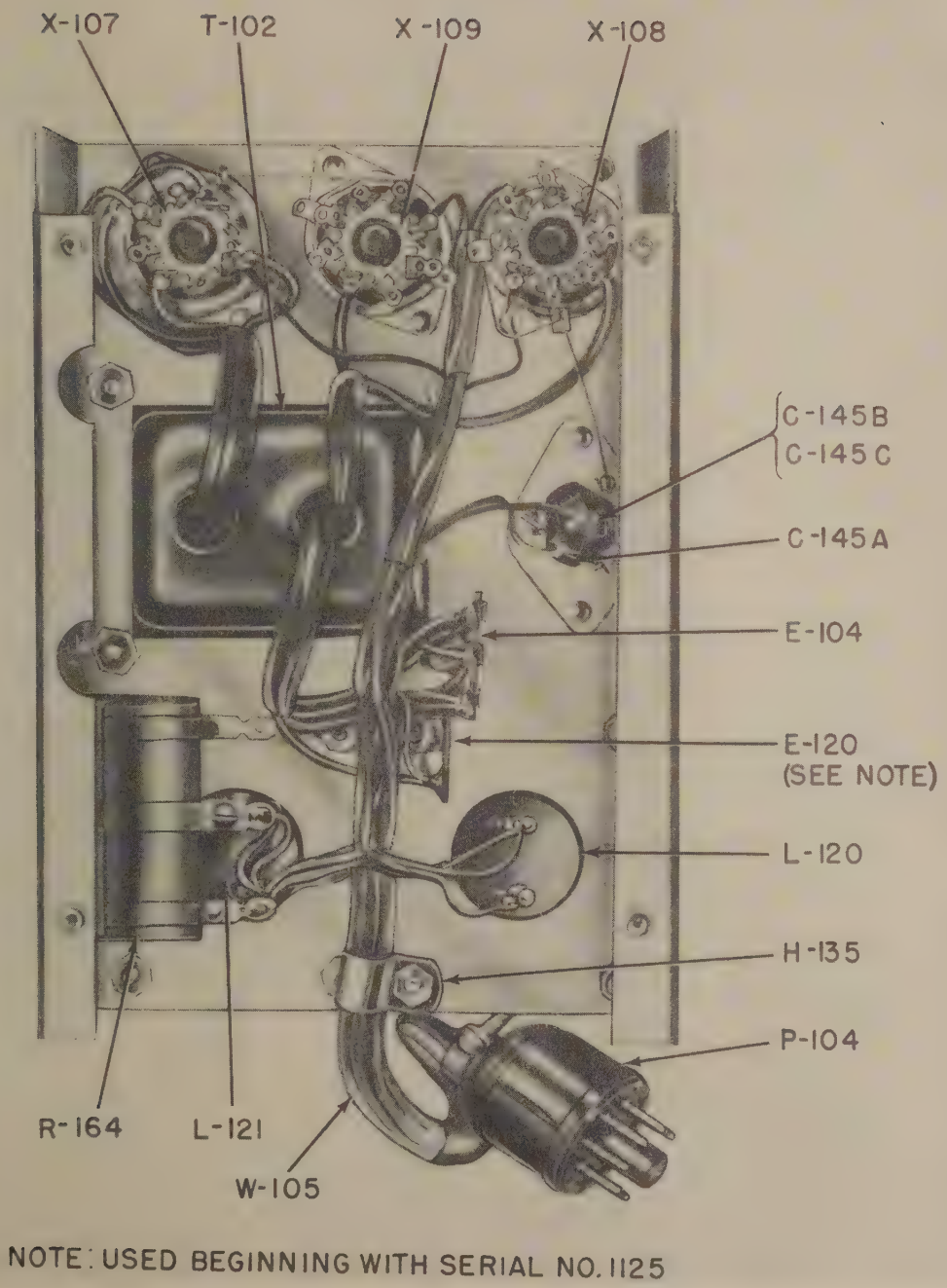


Figure 6-6. Power Supply, Bottom View

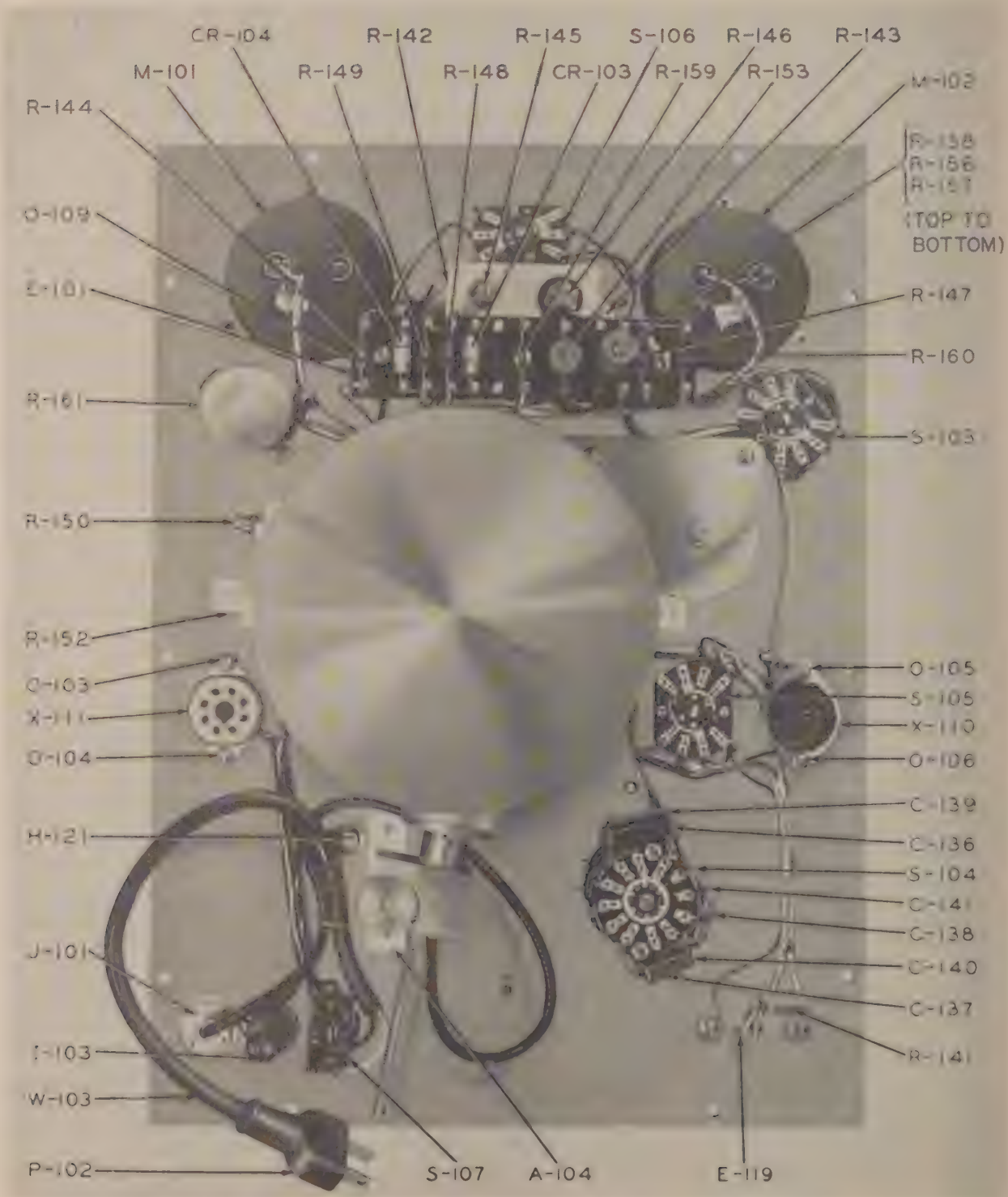


Figure 6-7. Panel Assembly, Rear View (Serial No. 1-1124)

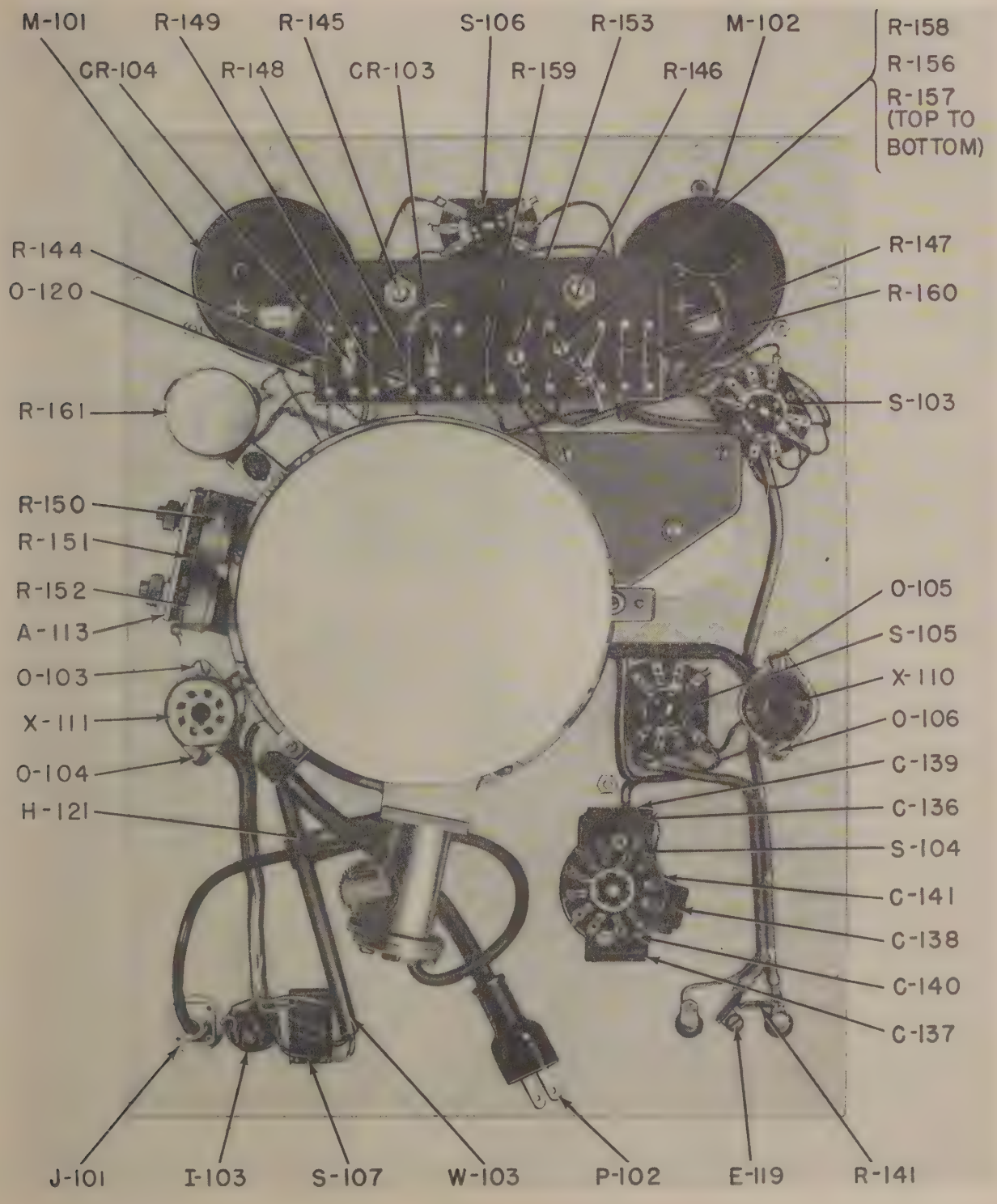


Figure 6-7A. Panel Assembly, Rear View (Serial No. 1125 and following)

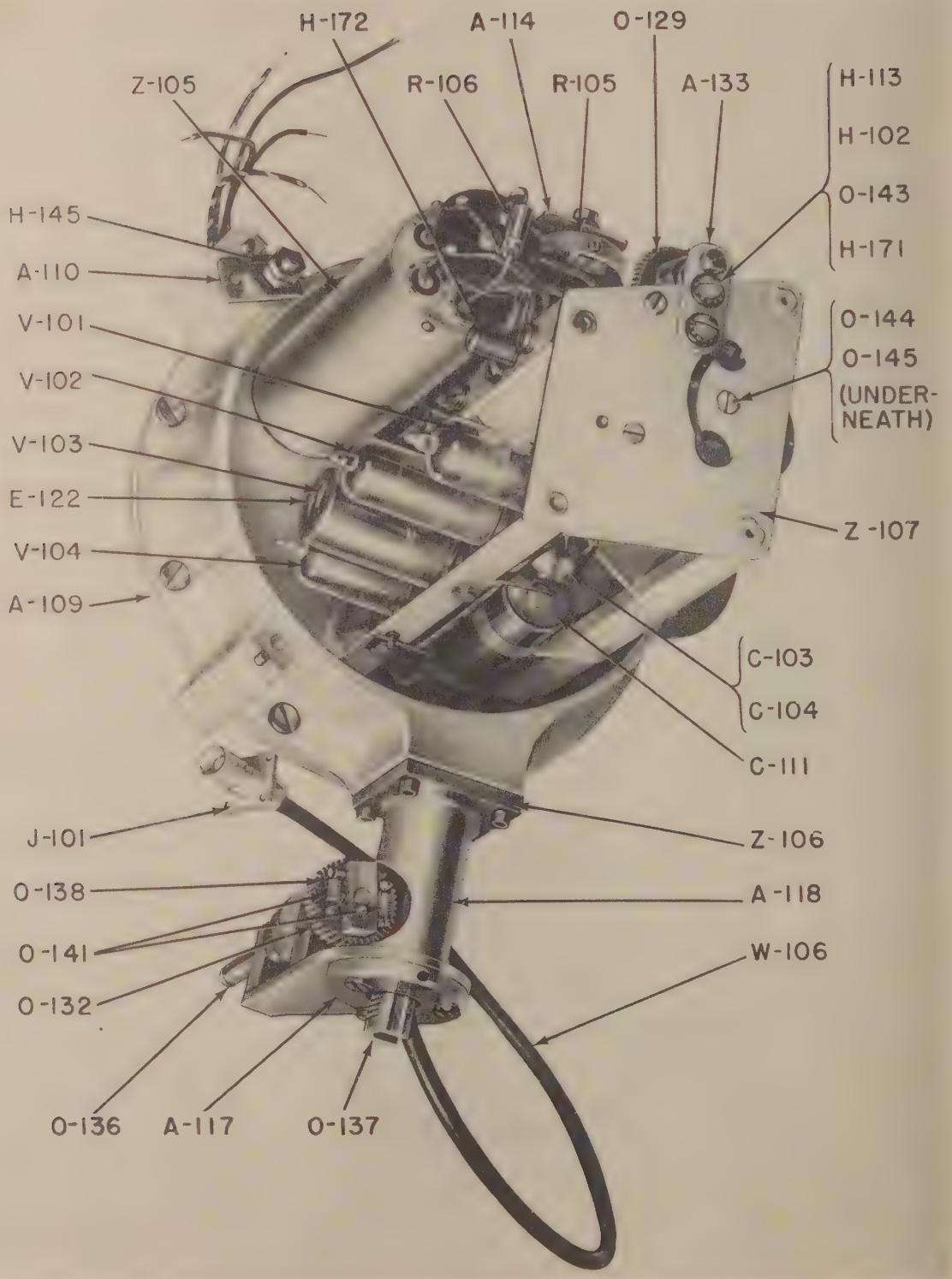


Figure 6-7B. R-F Unit Z-101, Left Oblique View, Cover Removed

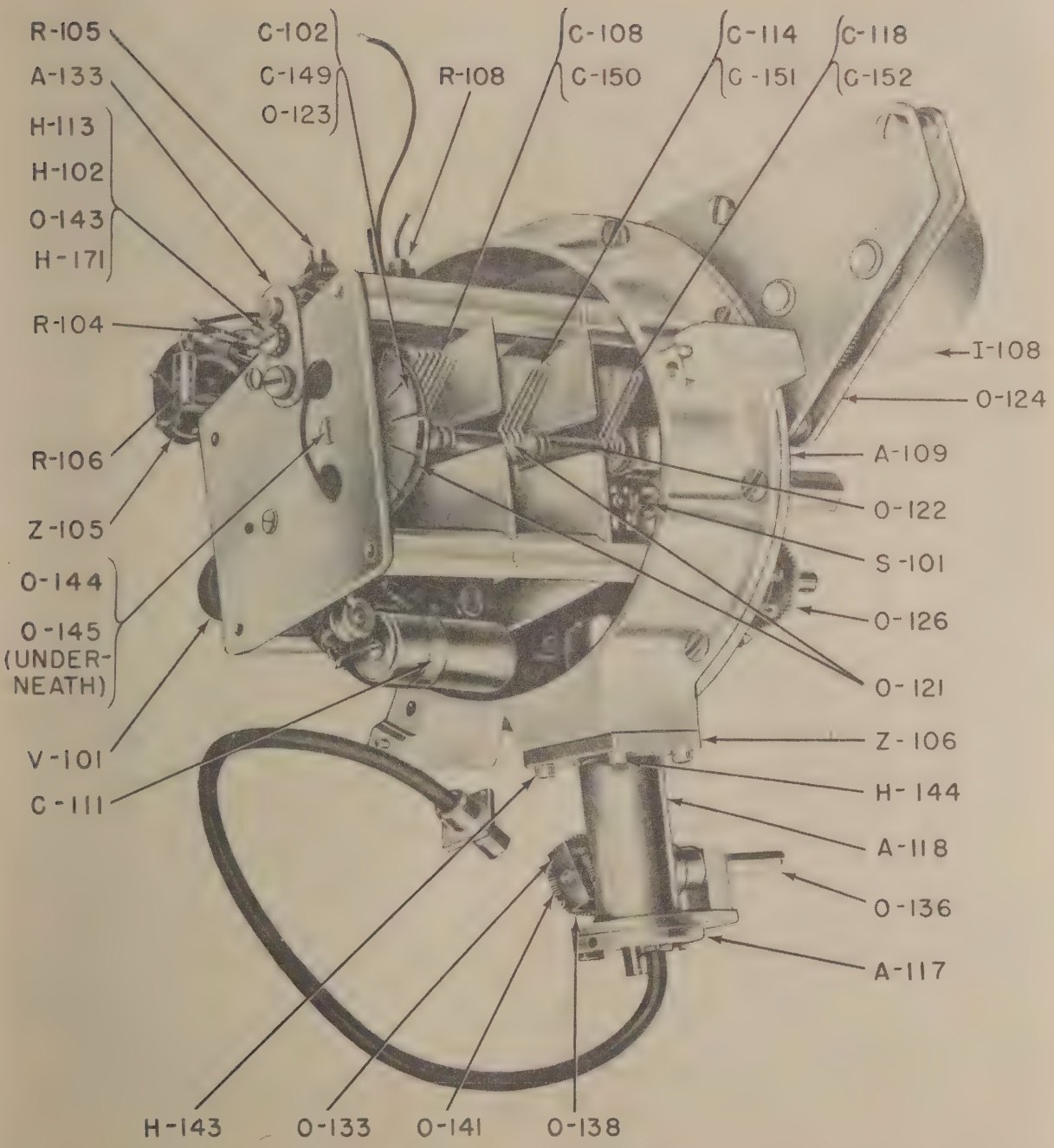


Figure 6-7C. R-F Unit Z-101, Right Oblique View, Cover Removed

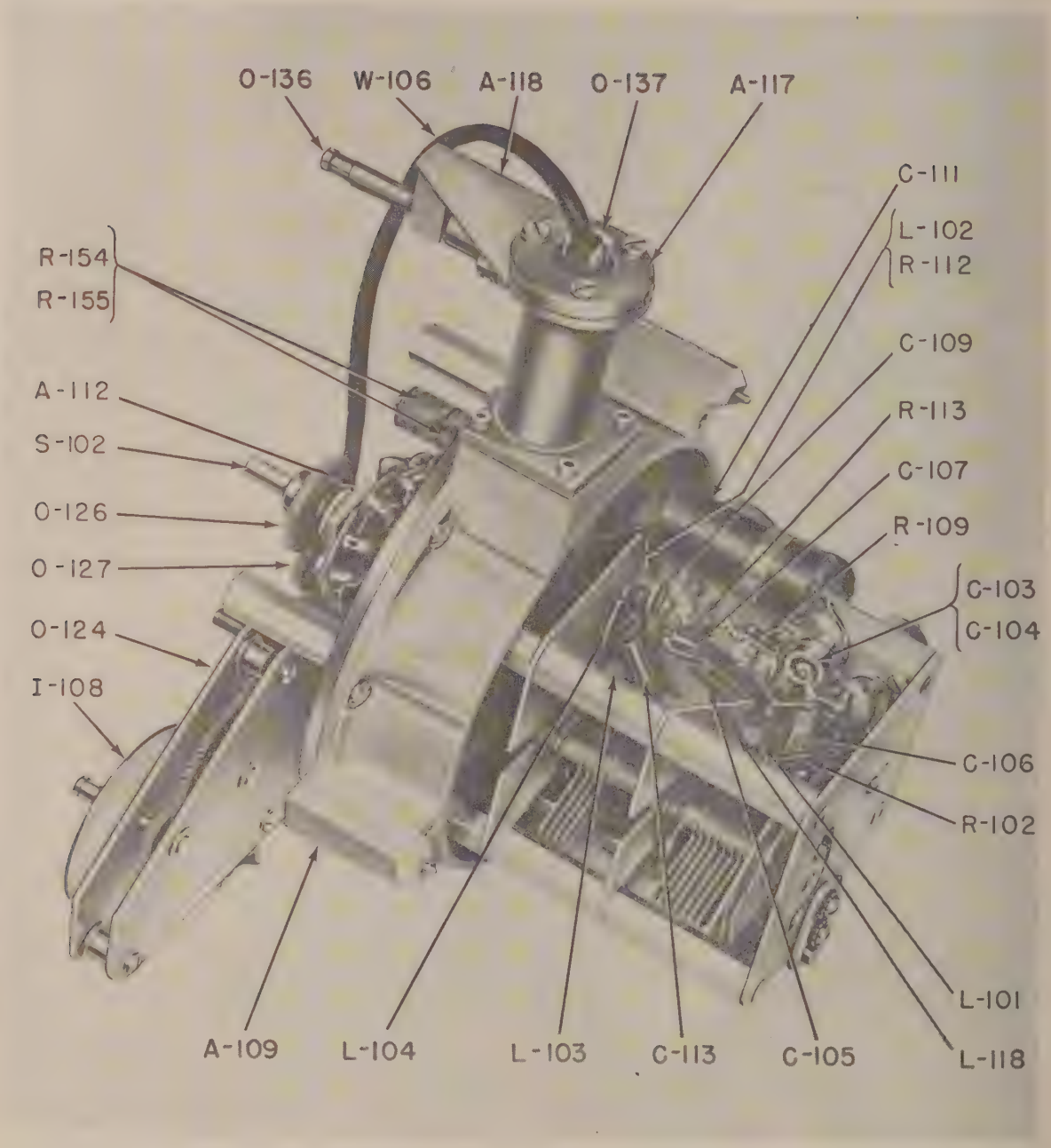


Figure 6-7D. R-F Unit Z-101, Bottom Oblique View, Cover Removed

6-20. PROCEDURE FOR LOCALIZING TROUBLE TO THE R-F UNIT.

Note

Insofar as "Condition Two", outlined in paragraph 6-22, is concerned, it is assumed that any trouble condition in the audio unit, power unit, or panel assembly (excluding the r-f unit), which prevents the modulation meter M-102 from operating under the test conditions outlined in steps b. and d. of paragraph 6-22, has been corrected.

6-21. CONDITION ONE. Under this condition the a-f assembly is operating normally but there is no r-f output from J-101 or r-f reading on M-101.

a. Remove the panel assembly (refer to paragraph 6-10) and unplug the power supply from the panel (P-104 from X-111).

b. Remove the power supply from the cabinet. Refer to paragraph 6-14.

c. Connect the power supply by means of clip test leads on pin 3 or 7 of V-108 (grey lead), and on the grey lead on E-104 to a 117-volt, 50- to 60-cycle a-c source through the General Radio Type 200CM variable transformer.

d. Adjust the Type 200CM variable transformer for an input of 117 volts and, using Multimeter TS-352/U, make the following measurements (under no load conditions):

The a-c filament voltage from terminal 7 of R-163 to chassis. A reading of 14.8 volts rms, ± 10 percent should be obtained.

The B+ unregulated voltage at the C-145B and C-145C terminals (which are soldered together). A reading of 267 volts d-c, ±10 percent should be obtained.

The B+ regulated voltage (150-volt supply) across terminals 2 and 5 of V-108. A reading of 153 volts d-c, ±10 percent should be obtained.

e. Disconnect the power supply from the test set-up and re-connect P-104 to X-111. Using Multimeter TS-352/U, make the following measurements:

The regulated voltage (150-volt supply) from terminal 2 of X-111 (red with white tracer) to chassis. A reading of 150 ± 5 volts d-c should be obtained.

Turn the "RF" level control, R-161, full clockwise and measure the screen supply voltage from the arm (center terminal) of R-161 to chassis. A reading of 138 ± 5 volts d-c should be obtained.

The a-c filament supply voltage to the r-f assembly at terminal 5 of X-111, the power supply connector (brown lead). A reading of 6.8 ± 0.5 volts a-c should be obtained.

f. Test the r-f monitor meter M-101 for continuity by passing not more than 100 microamperes through it.

g. Using Multimeter TS-352/U, check the operation of R-161 by measuring the d-c voltage between the arm and chassis as it is rotated through its range. A steady increase in voltage from zero volts d-c to 138 ±5 volts d-c should be obtained as the "RF" control knob E-108 is rotated from extreme counterclockwise to extreme clockwise position.

h. If all readings obtained are normal, it may be assumed that the trouble lies within the r-f assembly and that replacement of this assembly is required. Refer to paragraphs 6-16 and 6-17.

6-22. CONDITION TWO. Under this condition the r-f output is normal but there is no audio modulation of the output signal. Check the operation of the audio oscillator assembly as follows:

a. Remove the panel assembly (refer to paragraph 6-10, steps a. and b. only), connect the equipment to a nominal 117-volt 50- to 60-cycle a-c source, and apply power to the equipment.

b. Set the "MODULATION METER" switch S-106 to "AM", R-161 full counterclockwise, and set R-142, the "AM" control, for "50%" as indicated on M-102.

c. Using the ME-6A/U voltmeter, check the amplitude modulating voltage by reading the a-c voltage at the top of R-161 to chassis. A reading of 47 volts rms, ±20 percent should be obtained.

d. Set the "RF RANGE" knob E-110 of switch S-102 in the "OFF" position, the "MODULATION METER" switch S-106 to "FM", and the "FM" control R-143 for 240 kc deviation as read on M-102 on the 240-kc range.

e. Using the ME-6A/U voltmeter, check the frequency modulation by reading the a-c voltage at the bottom of R-153 (junction with R-154), located on the rear terminal board E-101, to chassis. A reading of 2.4 volts rms, ±5 per cent should be obtained.

f. If as a result of these tests it is observed that the modulation meter readings and the control operations are normal, it may be assumed that the audio oscillator is defective. Refer to paragraphs 6-12 and 6-13 for removal and replacement procedure.

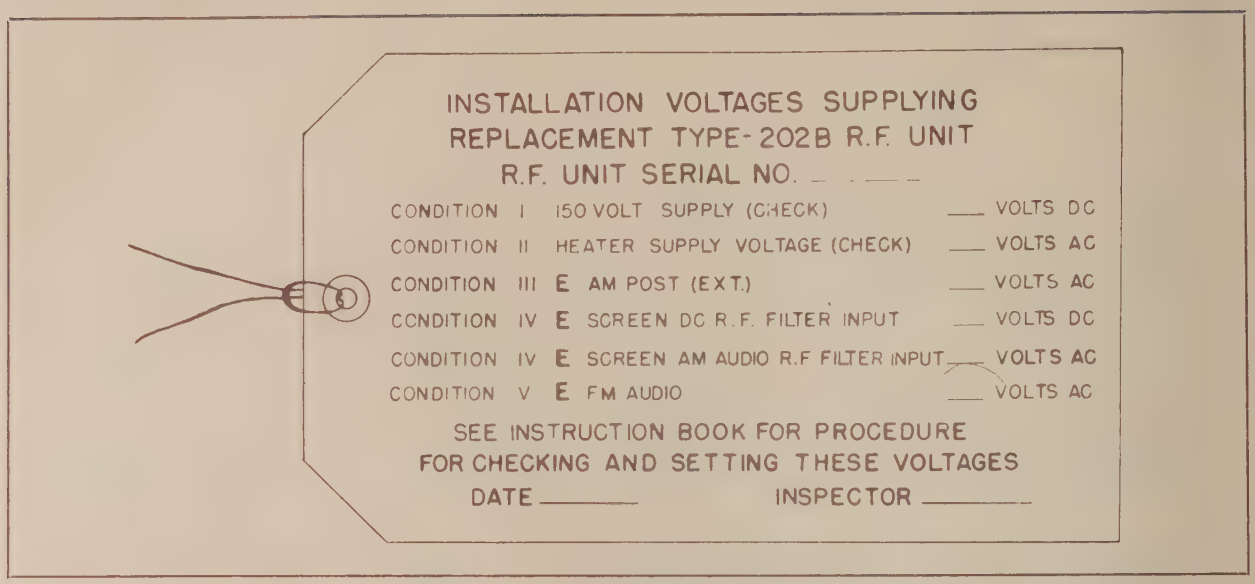

INSTALLATION VOLTAGES SUPPLYING
REPLACEMENT TYPE-202B R.F. UNIT
R.F. UNIT SERIAL NO. _ _ _ _
CONDITION I 150 VOLT SUPPLY (CHECK) ___ VOLTS DC
CONDITION II HEATER SUPPLY VOLTAGE (CHECK) ___ VOLTS AC
CONDITION III E AM POST (EXT.) ___ VOLTS AC
CONDITION IV E SCREEN DC R.F. FILTER INPUT ___ VOLTS DC
CONDITION IV E SCREEN AM AUDIO R.F FILTER INPUT ___ VOLTS AC
CONDITION V E FM AUDIO ___ VOLTS AC
SEE INSTRUCTION BOOK FOR PROCEDURE
FOR CHECKING AND SETTING THESE VOLTAGES
DATE _____ INSPECTOR _____

Figure 6-8. Sample Inspection Tag, Replacement R-F Assembly

6-23. MAINTENANCE OF MODULATION FREQUENCY SWITCH, S-104.

6-24. REPAIR OF MODULATION FREQUENCY SWITCH, S-104. S-104 employs six mica capacitors which are mounted on the outside of the wafer sections and therefore are easily accessible for replacement. These are C-136, C-137, C-138, C-139, C-140, and C-141. When replacing any one of these parts, note its relative position and connections carefully (see figure 9-2). Unsolder the defective capacitor and replace with a new one, soldering it securely in position. Take care to place the new part in the same place and with the same lead length as originally employed.

6-25. REMOVAL OF MODULATION FREQUENCY SWITCH, S-104. To remove S-104 completely, proceed as follows:

a. Unsolder the black wire, the green wire, and the blue wire with white tracer from the switch terminal connections. (See figure 9-2.)

b. Using a No. 10 Allen wrench, loosen the two set screws in the knob of dial I-105 and remove the dial.

c. Remove the hex nut from the front of the panel and remove the switch assembly. Remove the shoulder bushing from the switch shaft.

6-26. REPLACEMENT OF MODULATION FREQUENCY SWITCH, S-104. To replace S-104, proceed as follows:

a. Place the shoulder bushing on the shaft of S-104 and insert the switch assembly through the mounting hole on the front panel.

b. Rotate the assembly so that C-136 and C-139, the 0.01-μf capacitors, are approximately on top and secure S-104 in position with the hex nut.

c. Rotate the shaft full counterclockwise. Place the dial I-105 on the shaft in such a position that the dial calibration "50" is aligned with the fiducial line above it. Secure the dial by tightening first the topmost set screw in the knob, and then the remaining set screw, with a No. 10 Allen wrench.

d. Rotate the dial and check that each calibration marking aligns with the fiducial line, and that there is no slipping or binding during rotation.

e. Resolder the blue-white tracer wire, the green wire, and the black wire to S-104. (See figure 9-2.)

SECTION VII

OVERHAUL OF MECHANICAL COMPONENTS

7-1. OVERHAUL OF GEAR ASSEMBLY O-124.

7-2. REMOVAL OF GEARING ASSEMBLY. Refer to paragraph 6-16H. Remove only if unit requires replacement of gearing assembly and for annual inspection.

7-3. CLEANING AND INSPECTION OF THE GEARING ASSEMBLY. (Refer to Table 4-1.) Wipe gears with a cloth. Check for backlash by rotating the vernier gently, holding fixed the main frequency dial, marked "FREQUENCY MC." The backlash should not exceed two divisions of the vernier dial. Correct backlash by adjusting the rear bearing of the gearing unit main drive shaft. This bearing is at the rear of the Z-101 r-f tube shelf, secured by two screws. Loosen the screws and allow the shaft to center itself in the bearing; then tighten the screws, being careful not to shift the bearing. Repeat the procedure if backlash is still present.

7-4. OVERHAUL OF GEARING ASSEMBLY. The gearing assembly is procured as a unit. Overhaul should be undertaken only for the purposes of preventive maintenance. See Table 4-2 for lubrication instructions.

7-5. OVERHAUL OF ATTENUATOR ASSEMBLY Z-106.

7-6. REMOVAL OF ATTENUATOR ASSEMBLY. Refer to paragraphs 6-16C and 6-16D. Check cable continuity and resistance, rack and pinion gears, cable connections, and tension of springs on hub and pin assembly. See Table 4-2 for lubrication instructions.

7-7. CLEANING AND INSPECTION OF ATTENUATOR ASSEMBLY. Wipe gears and inspect for broken teeth. Turn shaft until attenuator cable rack gear extends outside attenuator tube. Check gear for broken teeth. Wipe gear. For repair or replacement see paragraph 6-16D.

7-8. OVERHAUL OF ATTENUATOR ASSEMBLY. Check resistor holder to see that it is securely screwed into attenuator rack gear. See Table 4-2 for lubrication instructions.

SECTION VIII

ALIGNMENT, CALIBRATION, AND TESTS

8-1. GENERAL.

8-2. Electrical and calibration adjustments and production tests made at the factory are described in this section to facilitate the work of maintenance personnel who may be required to repair or recondition the Type 202-B. Before these adjustments and tests can be made, the equipment must be disassembled into its major subassemblies. Refer to paragraph 6-9.

8-3. POWER SUPPLY ASSEMBLY TESTS.

8-4. To check the power supply assembly proceed as follows:

a. Interconnect all the assemblies, connect the primary power cable to a nominal 117-volt 50- to 60-cycle a-c power source, and apply power to the equipment. Allow the equipment to warm up for a minimum period of 30 minutes.

b. Set the "FM-OFF-AM" switch to "OFF" and the r-f monitor meter M-101 to the red line by means of the "RF" control.

c. Using Multimeter TS-352 U, measure the unregulated a-c filament voltage at terminal 4 of X-111. A reading of 6.3 volts a-c should be obtained.

d. Measure the B+ unregulated voltage to chassis at terminal 3 of X-111. A reading between 225 and 270 volts d-c should be obtained. Measure the regulated voltage at terminal 2 of X-111. A reading of 150 ±5 volts d-c should be obtained.

e. Set the "FM-OFF-AM" switch to "OFF."

f. Measure the a-c voltage on terminal 2 of X-111. A reading not greater than 30 millivolts should be obtained.

g. Connect a variable transformer, General Radio Type 200CM, between the primary power source and the Type 202-B equipment.

h. With the line voltage adjusted first to 105 volts and then to 125 volts, measure the regulated d-c voltage with multimeter TS-352 U at terminal 2 of X-111 and the regulated filament voltage at terminal 5 of X-111. Compute the regulation by subtracting the 105-volt readings from those taken at the 125-volt input. The limits are as follows:

	105 Volts	*125 Volts*	*Regulation*
Filament	6.3 v, min	7.3 v, max	0.4 v, max
DC	145 v, min	155 v, max	5 v, max

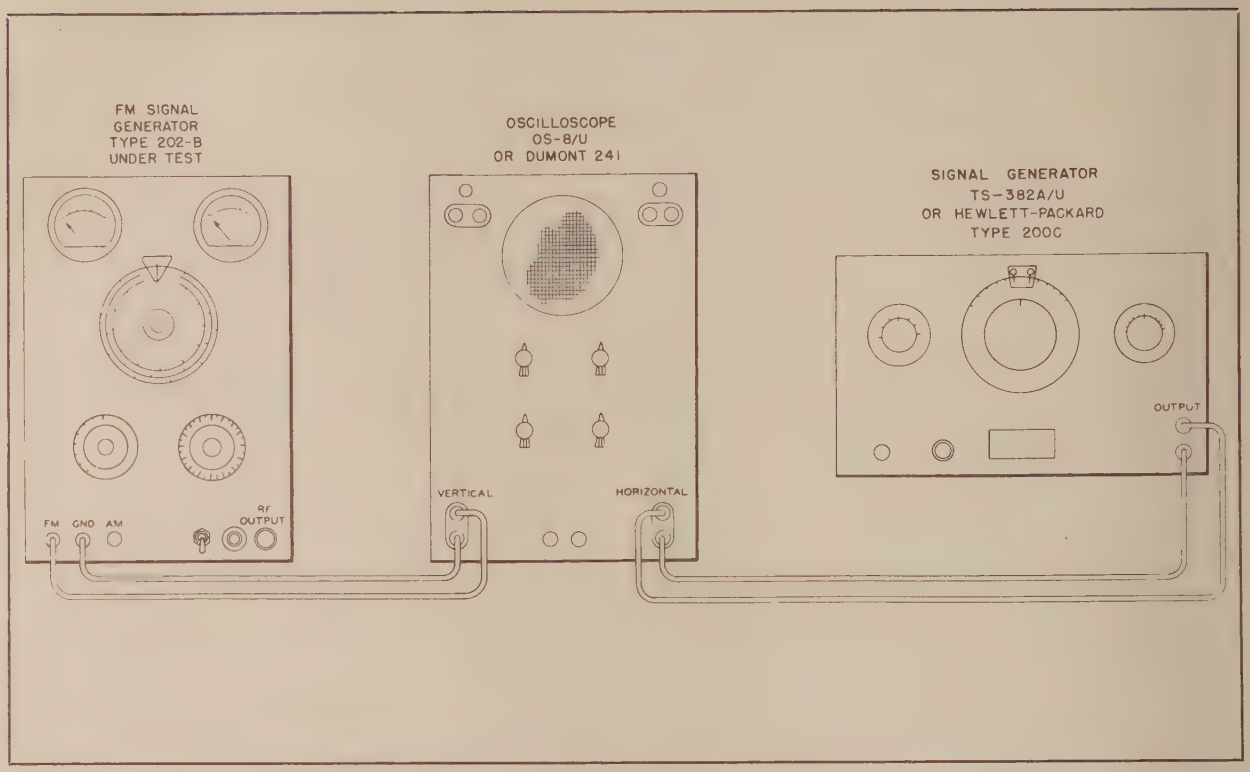


Figure 8-1. Frequency Check of Audio Modulating Frequencies, Test Connection Diagram

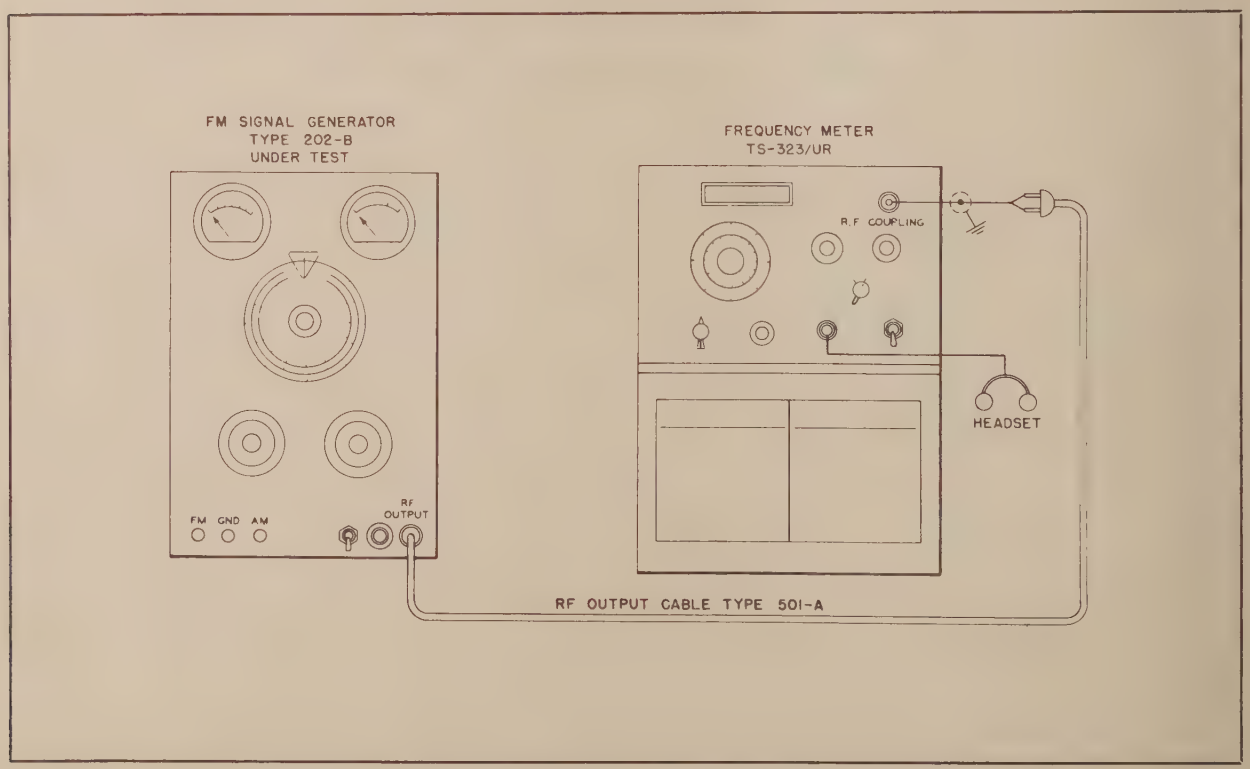


Figure 8-2. Frequency Calibration Test, Test Connection Diagram

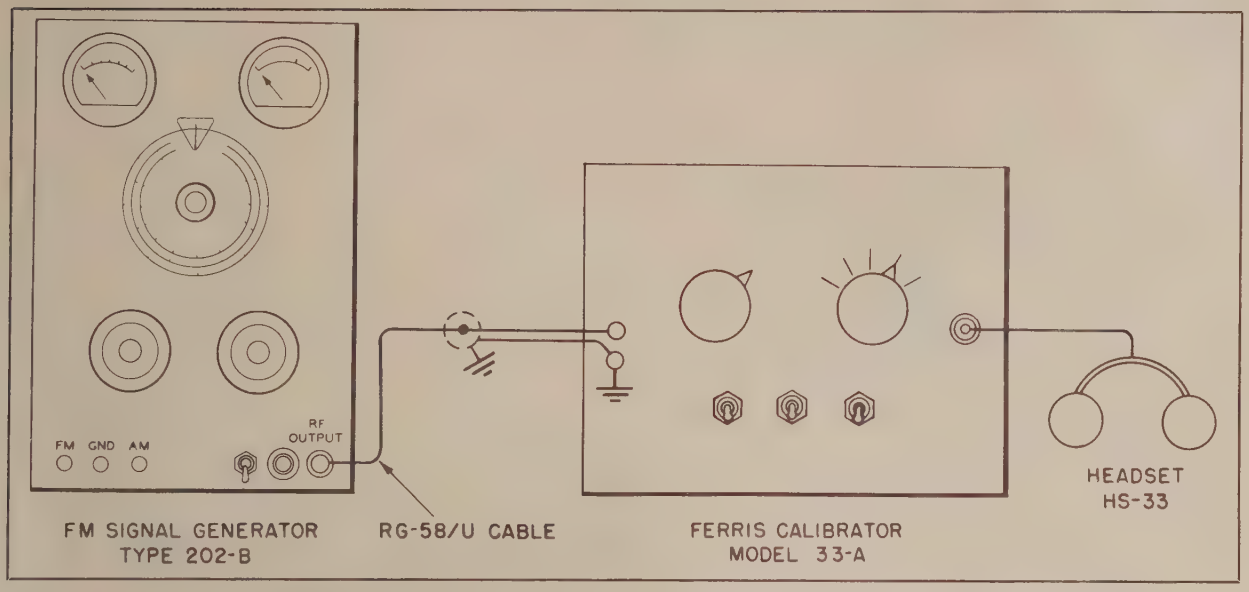


Figure 8-3. Dial Backlash and Oscillator Calibration Tests, Test Connection Diagram

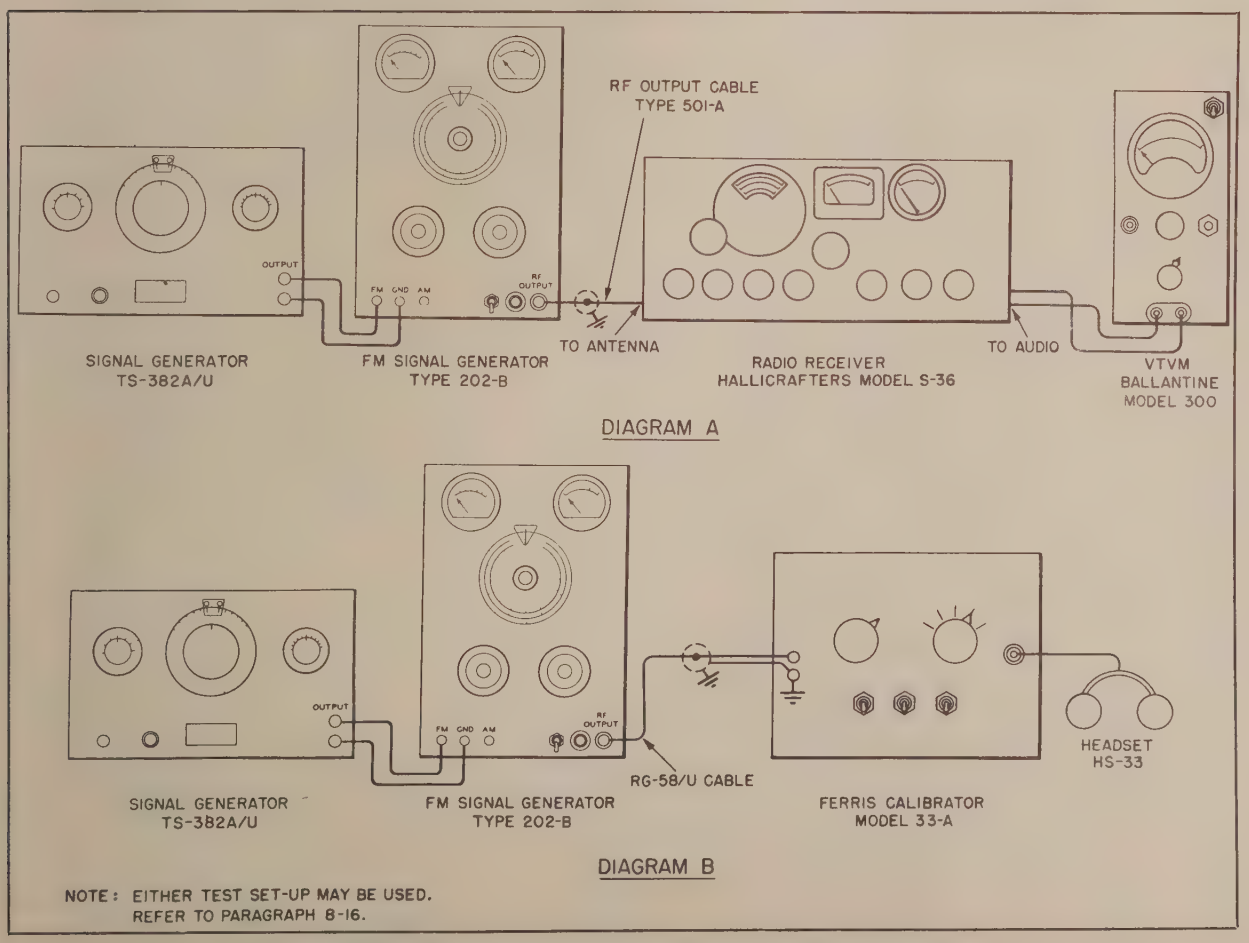


Figure 8-4. FM Deviation Test, Test Connection Diagrams

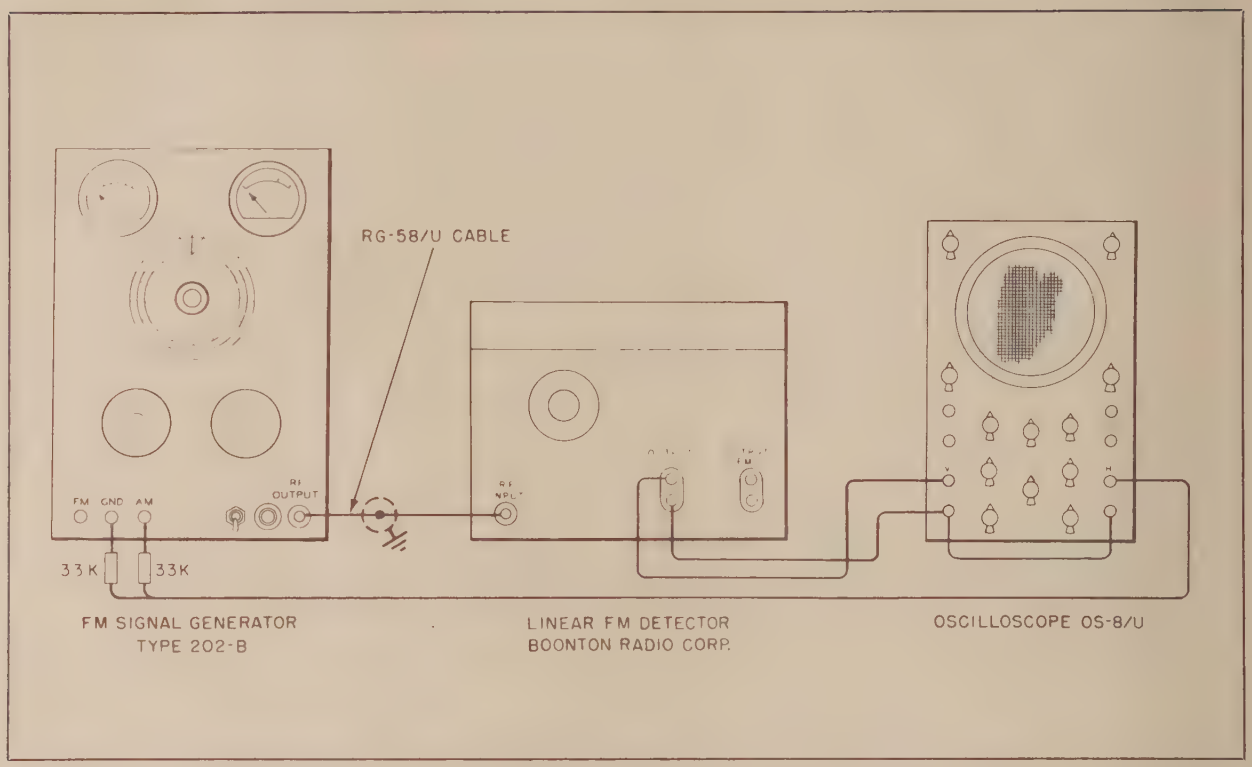


Figure 8-5. AF Distortion Test, Test Connection Diagram

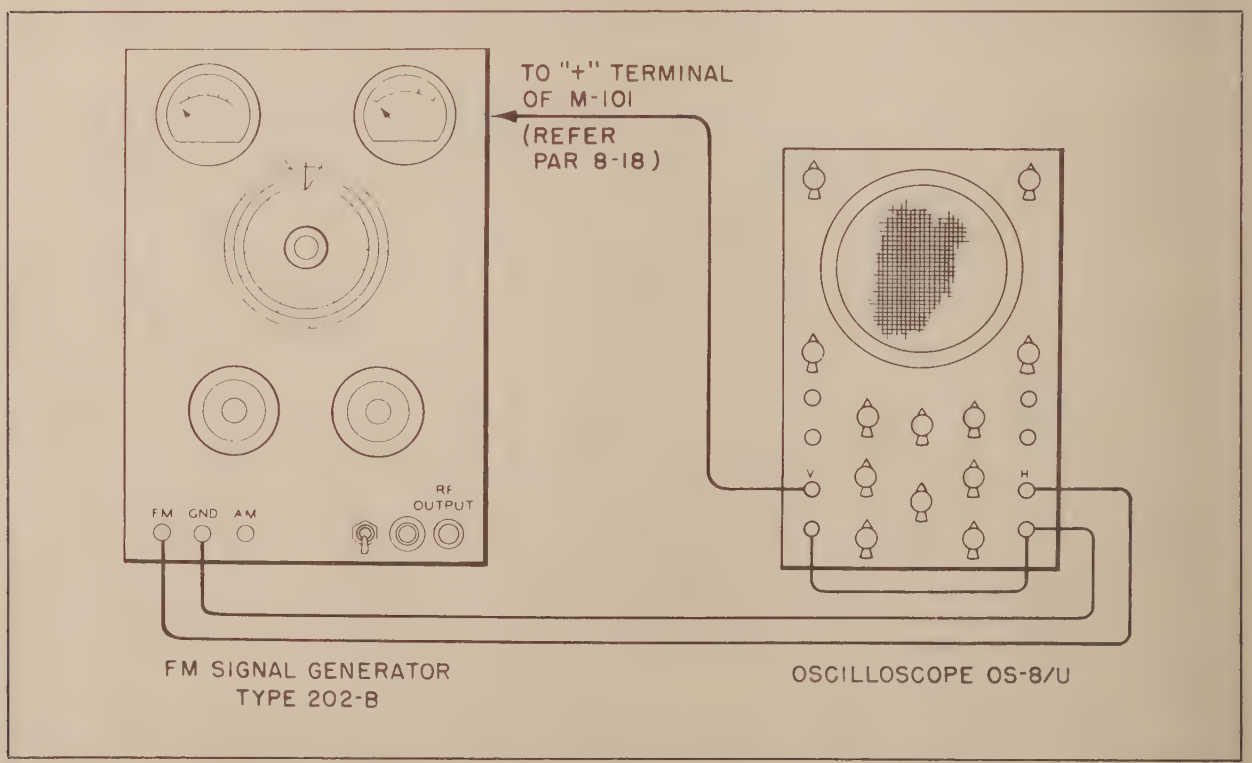


Figure 8-6. Output Stage Alignment, Test Connection Diagram

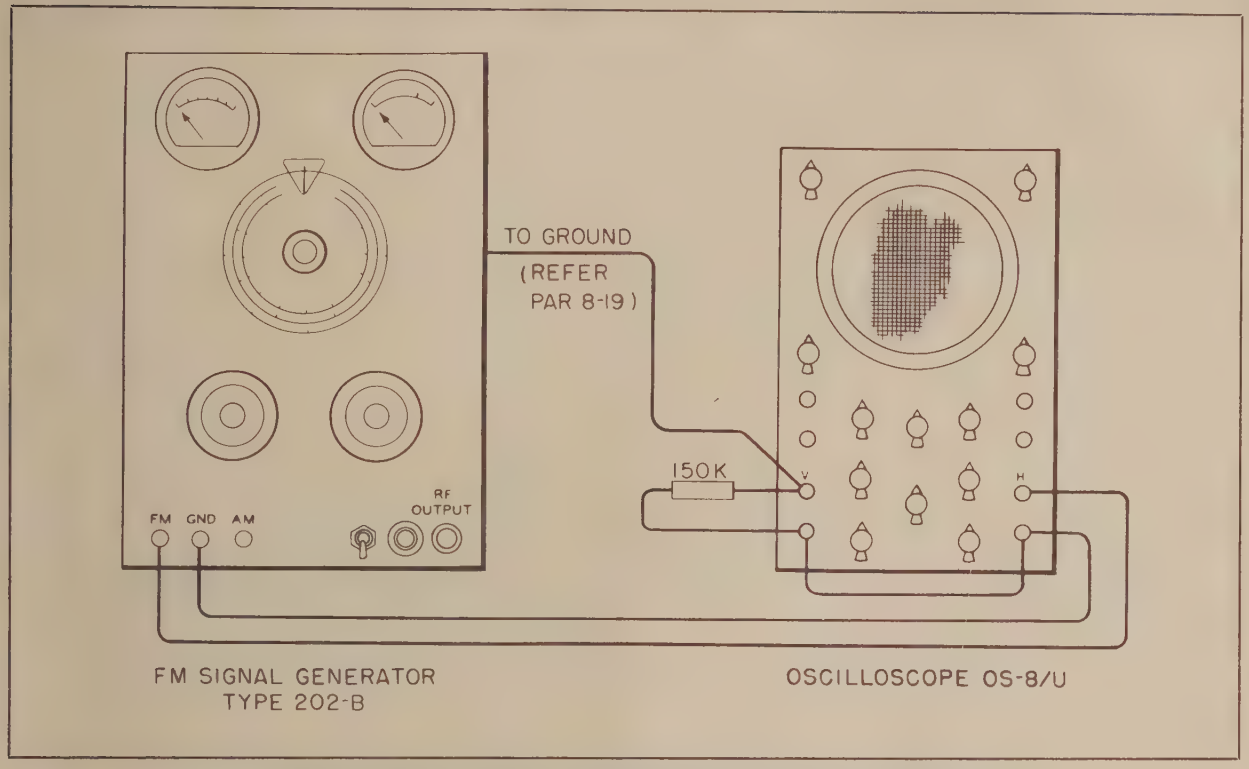


Figure 8-7. Doubler Stage Alignment, Test Connection Diagram

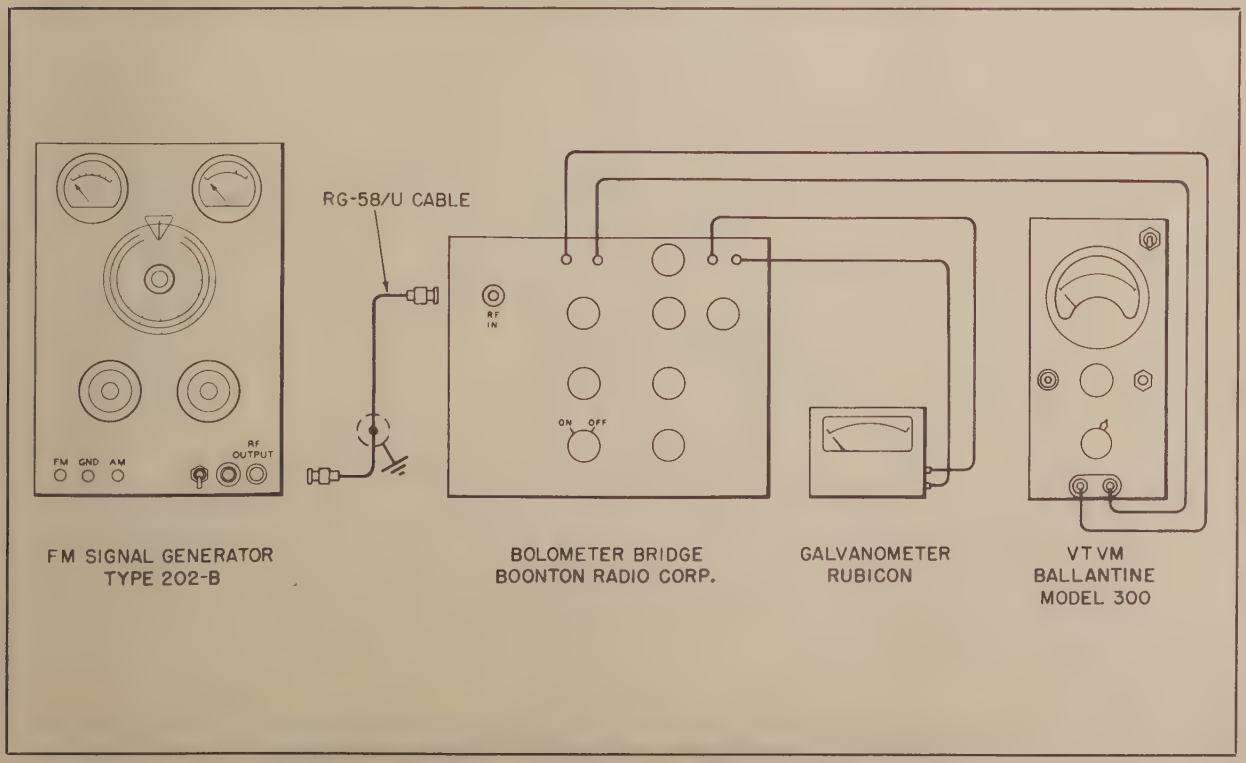


Figure 8-8. Attenuator Alignment, Test Connection Diagram

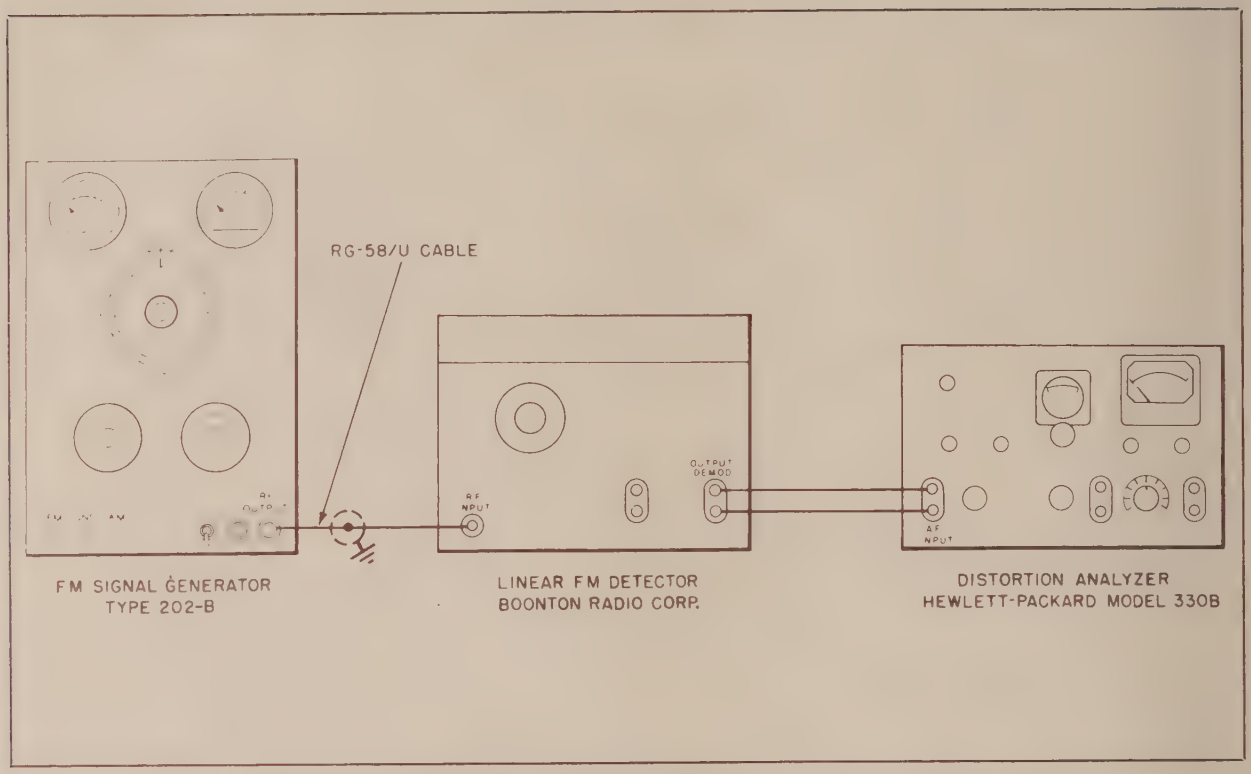


Figure 8-9. Amplitude Modulation Percentage Test, Test Connection Diagram

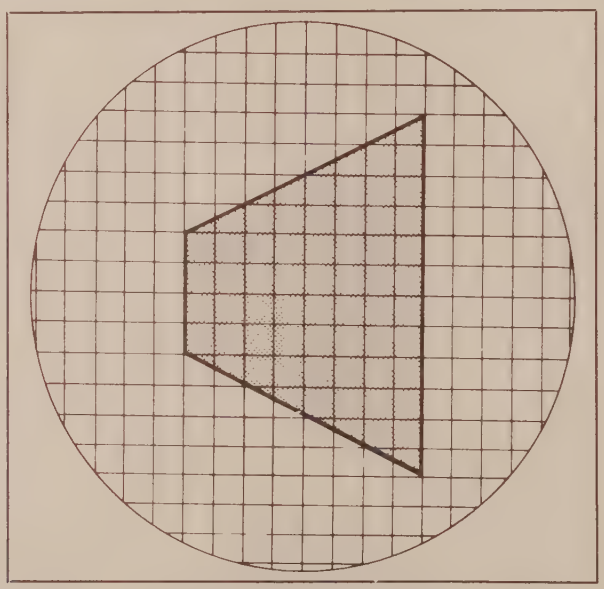


Figure 8-10. Amplitude Modulation Percentage Test, Oscilloscope Pattern

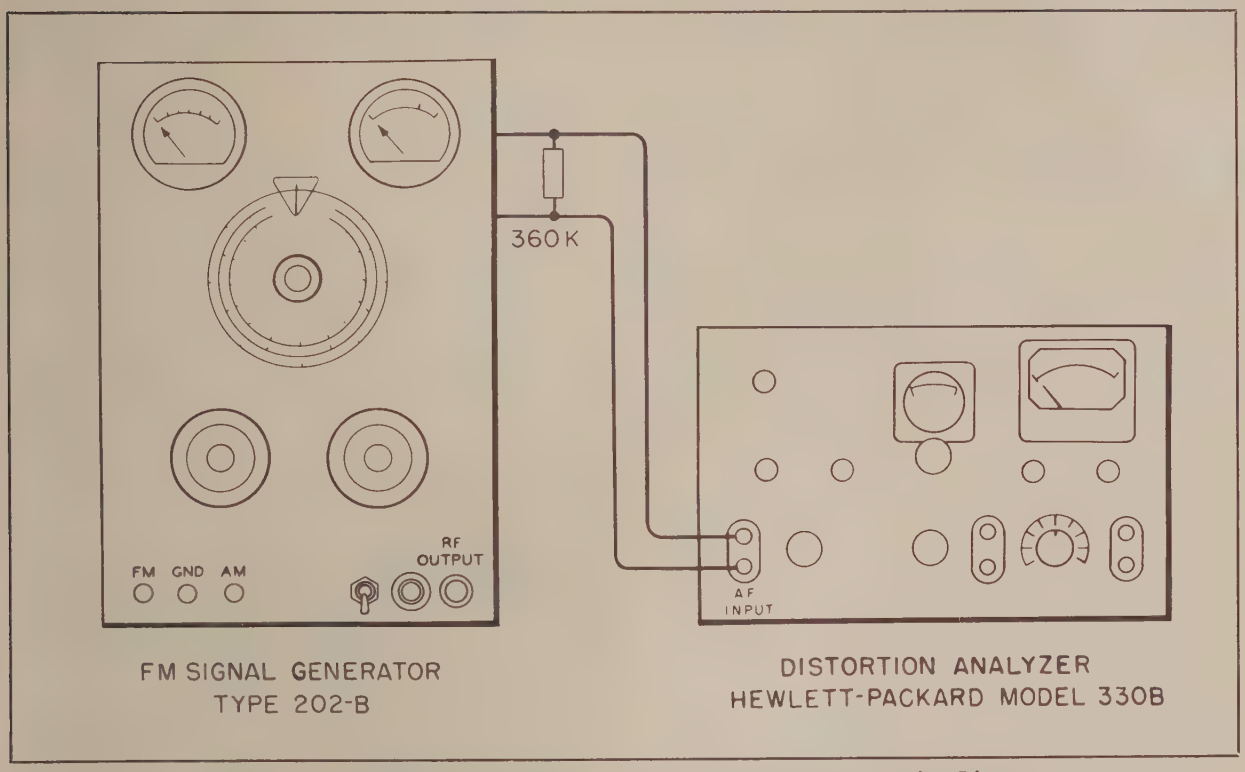


Figure 8-11. Amplitude Modulation Distortion Test, Test Connection Diagram

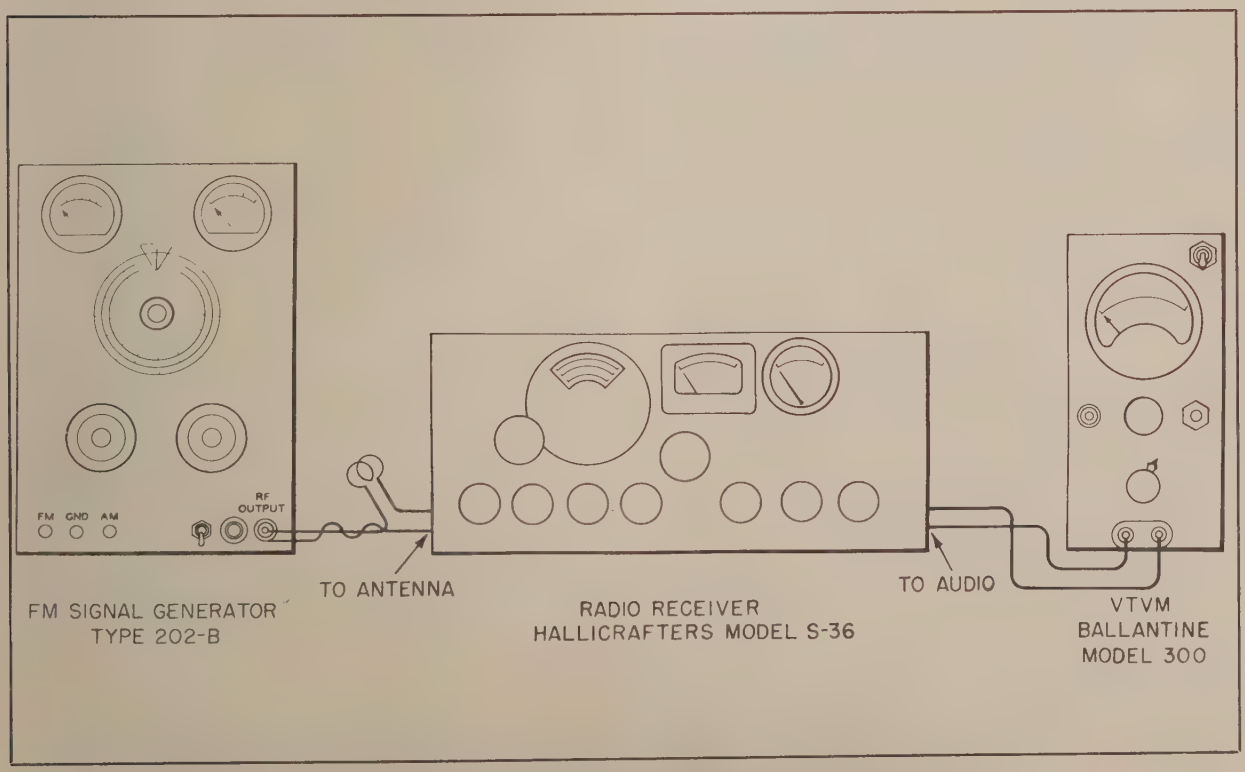


Figure 8-12. R-F Leakage Test, Test Connection Diagram

8-5. AUDIO OSCILLATOR ASSEMBLY TESTS.

8-6. Check the audio oscillator assembly as follows:

a. Interconnect all the assemblies, connect the primary power cable to a nominal 117-volt 50- to 60-cycle a-c power source, and apply power to the equipment. Allow the equipment to warm up for a minimum period of 30 minutes.

b. To check the audio modulating voltage over the audio oscillator frequency range, set the "RF RANGE" switch on "54-108," the "FREQUENCY MC" dial at 60 mc, the "INT MOD" switch on "AM," the "MODULATION METER" switch to "AM," the "FREQ CPS" dial to 400 cps, the "MICROVOLTS" dial to 0.1 microvolt, the "AM" control for a modulation meter reading of "50%", and the "RF" control adjusted to set the r-f monitor meter M-101 to the red line.

c. Using the ME-6A U voltmeter, connected between the "AM" and "GND" binding posts, adjust R-136 for a reading of 55 volts. Vary S-104 from 50 to 15K cps and note the variation in this voltage. A variation of less than ±5 volts from the nominal 55-volt reading is permitted.

d. Rotate the "FM" control (R-143) full counterclockwise. Set the "MODULATION METER" to "FM", the "RF RANGE" switch to "54-108", the "FREQUENCY MC" dial at 60 mc, the "INT MOD" switch on "FM", the "FREQ CPS" dial to 400 cps, and the "MICROVOLTS" dial to 0.1 microvolt.

e. With the ME-6A U voltmeter connected between the "FM" and "GND" binding posts, vary S-104, the "FREQ CPS" control from 50 to 15K cps. The voltage should remain between 10 and 13 volts.

f. Connect the ME-6A U voltmeter between the oscillator side of R-141 and ground. Vary S-104 from 50 to 15K cps. The voltage should be 35 ±5 volts. Lock R-136.

g. Check the smoothness of operation of the resistance taper of R-142 and R-143 by slowly advancing and observing the pointer movement on M-102. Three types of unsatisfactory operation may exist: (1) intermittent contact which causes fluttering of the meter pointer, (2) non-linear taper which results in difficulty of accurate settings on the meter, and (3) a resistance taper that exhibits change of inflection, that is, an increase in meter deflection, a decrease, and then further increase with constant clockwise advancement of the potentiometer.

h. To make a frequency check of the audio modulating frequencies, interconnect the test equipment as shown in figure 8-1.

i. Set the "FM-OFF-AM" switch to "FM," the "MODULATION METER" switch to "FM", the "DEV KC" switch to "80" and the modulation meter M-102 to 80 kc.

j. Set the Type 202-B "FREQ CPS" control and the TS-382A U Signal Generator to all settings between 50 cps and 15 kc. Adjust the TS-382A U until a stationary Lissajous pattern in the form of a circle appears on the oscilloscope screen.

k. The audio frequency read directly on the TS-382-A U Signal Generator dial should compare with the nominal set frequency of the Type 202-B within ±5 per cent.

8-7. PANEL ASSEMBLY TESTS.

8-8. Check the panel assembly as follows:

a. Interconnect all the assemblies, connect the primary power cable to a nominal 117-volt 50- to 60-cycle a-c power source, and apply power to the equipment. Allow the equipment to warm up for a minimum period of 30 minutes.

b. Set the "RF RANGE" switch in the "OFF" position, the "MODULATION METER" switch to "FM", and with the ME-6A U voltmeter connected from the arm (center terminal) of R-143 to ground, advance R-143, the "FM" potentiometer, for a reading of 3.6 volts.

c. Using a test probe, connect the ME-6A U voltmeter, to the arm (center terminal, white wire) of S-102 and ground. Vary the frequency selector switch S-102 and the deviation range switch S-103, and record the voltages observed on the voltmeter. These voltages should be within the following limits:

Frequency Range	*Deviation Range*	*Voltage (volts)*
108—216	240	0.89 —0.91
108—216	80	0.294—0.306
108—216	24	0.088—0.092
54—108	240	1.78 —1.82
54—108	80	0.588—0.612
54—108	24	0.176—0.184

d. Set the frequency range switch S-102 on "54-108" and the deviation range switch S-103 to "80." Using a test probe, connect the ME-6A/U voltmeter to the arm (center terminal, white wire) of S-102 and ground. Check the linearity of the modulation meter circuit by advancing R-143 until M-102 reads exactly 80 kc and record the reading on the ME-6A/U voltmeter. Repeat with adjustment of R-143 for M-102 indications of 70, 60, 50, 40, 30, 20, and 10 kc. At no point should there be a difference in the voltage reading of more than ±0.02 volt from the nominal voltage listed below:

Deviation Setting	*Voltage (volts)*
80	0.8
70	0.7
60	0.6
50	0.5
40	0.4
30	0.3
20	0.2
10	0.1

8-9. FREQUENCY CALIBRATION TEST.

8-10. To check the frequency calibration of the Type 202-B proceed as follows:

a. Interconnect the equipment as shown in figure 8-2.

b. Apply power to the Type 202-B and allow it to warm up for a minimum period of one hour.

c. Set the "RF RANGE" switch to "54-108," the "FM-OFF-AM" switch to "OFF," the "MICROVOLTS" dial to "200K," and the r-f monitor meter M-101 at the red line by means of the "RF" control.

d. Set the "FREQUENCY MC" dial to 54 mc.

e. Adjust the TS-323/UR frequency meter for zero beat.

f. Compare the Type 202-B and TS-323/UR dial readings. The "FREQUENCY MC" dial reading should be within ±0.5 per cent of the TS-323/UR dial reading.

g. Repeat steps d., e., and f. for Type 202-B dial settings from 55 mc through 108 mc in one-megacycle increments. The readings should be within ±0.5 per cent of the TS-323/UR dial readings.

Note

Since the high-frequency range of 108 to 216 mc is achieved by doubling instead of amplifying in the final stage of the Type 202-B, the accuracy of this range is that of the 54-108 range, insofar as percentage tolerance is concerned, and therefore need not be checked.

h. If the "FREQUENCY MC" dial settings do not fall within the tolerance specified, reset the dial. Refer to paragraph 6-17, step p.

8-11. R-F ASSEMBLY ADJUSTMENT, CALIBRATION, AND ALIGNMENT.

8-12. Adjustment and recalibration of the r-f assembly is essential after any minor or major repair to the r-f assembly. These maintenance procedures are described in paragraphs 8-13 through 8-25. For adjustments after replacement of the r-f assembly as a complete unit, refer to paragraph 6-18. After interconnecting the equipment and applying power to the units, a minimum warm-up period of 30 minutes must be allowed before proceeding with the test procedure. If any tubes are to be replaced, they must be specially selected. Refer to paragraph 4-7. For all equipment interconnection use as short a length of wire or cable as is practical.

8-13. ADJUSTMENT OF DIAL I-108. Before proceeding to calibrate the r-f assembly oscillator, check for and adjust any backlash existing in dial I-108, as follows:

a. Interconnect the equipment as shown in figure 8-3.

b. Set the "RF RANGE" switch to the "54-108" position.

c. Set the "MICROVOLTS" dial for a reading of 0.2 volts output.

d. Tune the Calibrator Ferris Model 33-A to 10 mc and lock it.

e. Zero-beat the unmodulated output of the Type 202-B, using the vernier dial I-108, with the Ferris Calibrator at 10-mc intervals in a counterclockwise direction, then clockwise. The backlash should not exceed two divisions of the vernier scale. If the backlash exceeds this limit, it may be corrected by adjusting the main drive shaft bracket bearing A-133 (see figure 6-7C). Loosen the two screws H-102, and allow the shaft to center itself in the bearing. Tighten the screws, being careful not to disturb the setting of the shaft. Recheck the dial and repeat the procedure if necessary.

8-14. ADJUSTMENT OF R-F MONITOR METER M-101. Before proceeding to calibrate the r-f assembly oscillator, check the operation of meter M-101 as follows:

a. With power applied to the 202-B, set the "FM-OFF-AM" switch to the "OFF" position.

b. Adjust the vernier dial control E-112 and observe the r-f monitor meter M-101 for a point of flat output over a range of 2 or 3 mc. Now move the vernier frequency dial first in one direction, then in the other. If the meter needle deflection is greater by one-sixteenth inch in one direction than it is in the other, or if the pointer jumps excessively with reversed rotation, excessive meter backlash is present. To correct this condition, tighten the capacitor rotor thrust bearing O-144 (see figure 6-7B). Recheck and adjust again if necessary.

8-15. CALIBRATION OF R-F ASSEMBLY OSCILLATOR. The Type 202-B oscillator is calibrated as follows:

a. Interconnect the equipment as shown in figure 8-3.

b. Set the "FM-OFF-AM" switch of the Type 202-B to the "OFF" position.

c. Locate the 100-mc signal of Calibration Model 33-A and then check the 108-mc beat.

d. Tune the Type 202-B to zero-beat with the 108-mc beat frequency.

e. Check the scale of the main frequency dial I-104 to see if the fixed signal agrees to within 0.5 per cent of the scale reading. If not, adjust the oscillator trimmer screw H-172 (see figure 6-7B) in the side of the oscillator section of the r-f tube shelf.

f. Now check the entire low frequency range from 108-to-54 mc at 1-mc intervals. A further adjustment may be necessary to bring the frequency dial calibration to within the optimum ±0.5%. This is done by bending uniformly the outer rotor plates of C-108 (see figure 6-7C).

8-16. FM DEVIATION ADJUSTMENT. The FM deviation of the Type 202-B may be checked by the application of the "Bessel Zero" method. Either of two audio signal sources may be used for modulation. If the audio oscillator within the Type 202-B has been accurately checked, it may be used as the modulating source at 7.5 or 10 kc, or an external oscillator having a known frequency in the range of 7 to 10 kc may be used. If the Type 202-B audio oscillator is used, the FM deviation test is performed as follows:

a. Interconnect the equipment as shown in diagram A or B of figure 8-4. Either a broadband superheterodyne receiver with a beat frequency oscillator or a calibrator having a fixed 10-mc frequency, may be used as a null detector.

b. Tune the radio receiver, or set the calibrator, to 60 mc.

c. Turn the "DEV KC" switch of the Type 202-B to position "24" (0-to-24 kc deviation scale). Turn the "MODULATION METER" switch to the "FM" position.

d. Adjust the "FM" deviation control, located directly to the right of the modulation meter, until the meter reads "O".

e. Adjust the "RF" control until the r-f monitor meter needle reaches the red line.

f. Set the "FM-OFF-AM" switch to the "FM" position and the "FREQ CPS" switch to the 10-kc setting.

g. Tune the "FREQUENCY MC" dial to the 60-mc setting, the "R-F" range switch directly below it to the 54-108 mc setting, and the "MICROVOLTS" dial to 0.2.

h. Advance the "FM" control and note the deviation frequencies at which the audio signal (monitored by the Ballantine Model 300) disappears. These should be at 2.405, 5.520, 8.654, 11.792, 14.931, 18.011 and 21.212 kc providing the modulating frequency is exactly 10 kc.

i. Calculate the deviation values using Bessel functions as follows: The modulation index is defined as

$$B = \frac{\Delta F}{f}$$

where

B = modulation index
ΔF = frequency deviation
f = modulating frequency

It follows that

$$\Delta F = Bf$$

Therefore, with 10 kc as the modulating frequency, nulls would be detected at deviation frequencies of 86.54, 117.92, 149.31, 180.71 and 212.12 kc. If the meter indications do not coincide with the calculated values of deviation, adjust the reactance tube cathode potentiometer R-105 until the nulls coincide with the calculated meter readings.

j. When an external AM modulating signal is used, connect the external oscillator to the "EXT OSC" "AM" and "GND" terminals. Turn the "FM-OFF-AM" switch to the "OFF" position, and follow the steps outlined in paragraph 8-15 except for step b. In tuning for nulls, the TS-382A/U is tuned against the third harmonic of the Ferris Calibrator fixed 10-mc setting.

8-17. AF DISTORTION TEST. Following the FM deviation adjustment outlined in paragraph 8-16, check the distortion of the 400-cycle audio frequency at a 65-mc and 75 kc deviation as follows:

a. Interconnect the equipment as shown in figure 8-5.

b. Set the "FREQUENCY MC" dial to 65 mc and the "DEV KC" control to the "80" position. Obtain a 7-kc deviation by adjusting the "FM" deviation control.

c. Measure the distortion in the Boonton Radio Linear FM Detector by means of the Hewlett-Packard Model 330 B.

d. Adjust the V-101 screen potentiometer R-108 for minimum distortion. If it is not less than 2 per cent, replace the reactance tube V-101 (refer to paragraph 4-7), since it is probably not operating on the linear portion of its g_m curve. If the tube is replaced, reset the deviation and then check distortion again.

e. With distortion at minimum, set the frequency deviation at 10-mc intervals over the 54-to 108 mc range, by bending the outer slotted rotor plates O-123 of the deviation capacitor C-102 (see figure 6-7C).

f. Recheck the oscillator frequency at 108 and 54 mc and readjust oscillator trimmer screw H-172 (see figure 6-7B) if necessary

8-18. OUTPUT STAGE ALIGNMENT.

Note

Any adjustment of the output (amplifier-doubler) stage affects the alignment of the first doubler stage. It is therefore advisable to align the output stage first.

To align the output stage proceed as follows:

a. Disconnect the positive lead of the r-f monitor meter M-101 and connect it to the vertical amplifier of the oscilloscope, and make the other equipment interconnections, as shown in figure 8-6.

b. Turn "FM-OFF-AM" switch to the "FM" position.

c. Set "MODULATION METER" switch to the "FM" position, and "DEV KC" switch to "240".

d. Adjust the "FM" deviation control for a reading of 150-kc deviation.

e. Adjust the vertical sweep of the oscilloscope so that the resonance curve peak is visible within the limits of the oscilloscope sweep.

f. Turn the "RF RANGE" switch to the "54-108" position.

g. Tune the Type 202-B to 108 mc.

h. Adjust the output trimmer screw H-174 (see figure 6-2) in the side of the tube shelf so that the peak is in the center of the sweep (maximum output) at 108 mc.

i. Tune over the remainder of the low frequency range to see that the resonance curve peak remains within the sweep limits. If adjustment is necessary, bend uniformly the outer slotted rotor plates of the output stage capacitor C-118 (see figure 6-7C) until the resonance peak remains within the limits over the whole low frequency range.

j. Switch the "RF RANGE" switch to the "108-216" position.

k. Recheck the alignment following the procedure previously outlined in steps a. to i., bending the outer rotor plates of C-118, if necessary, to keep the resonance curve centered within the sweep limits. The high frequency range will not track exactly when the low frequency range is tracked with the oscillator. Check the high and low frequencies, compromising where necessary to remain within the 150-kc deviation tolerance.

l. Reconnect the r-f monitor meter M-101 and take a reading at 108 mc on the low frequency range. Switch to the 108—216 mc range and tune the main frequency dial. If the meter indication does not fall below the reading at 108 mc, the high frequency range is in track.

8-19. DOUBLER STAGE ALIGNMENT. To align the doubler stage interconnect the equipment as shown in figure 8-7, disconnecting the ground side of the grid leak resistor R-114, and inserting a 150,000-ohm resistor. Follow the procedure outlined in steps c. through l. of paragraph 8-18, except adjust the outer slotted rotor plates of the doubler capacitor C-114 (see figure 6-7C).

8-20. INPUT VOLTAGE TESTS. Using Multimeter TS-352/U, measure the oscillator bias (pin 6 of V-102 and ground), the doubler drive (pin 1 of V-103 and ground), and the amplifier input (pin 1 of V-104 and ground). Readings obtained should be as follows:

Oscillator Bias: (V-102)	2 to 4 volts d-c
Doubler Input: (V-103)	5 to 10 volts d-c
Amplifier Input:	12 to 20 volts d-c

8-21. ATTENUATOR CALIBRATION. To calibrate the attenuator proceed as follows:

a. Connect the Boonton Radio Bolometer Bridge to a primary power source and to a galvanometer (see figure 8-8). Set the bolometer "AC" switch to "ON". Balance the bolometer bridge by adjusting the bolometer "DC" Control until a zero reading on the galvanometer is obtained. Set the bolometer "AC" switch to "OFF."

b. Interconnect all the equipment as shown in figure 8-8.

c. Set the "RF RANGE" switch to the "54-108" position, and set the "MICROVOLTS" dial to 50 K (0.05 volt). Balance the bolometer bridge against the Type 202-B by adjusting the "RF" potentiometer R-161.

d. Check the remainder of the low frequency range at 10-mc intervals for bridge balance.

e. Turn the "RF RANGE" switch to the 108-216 mc range and check at 20-mc intervals for bridge balance. Compromise on the setting of R-161 where necessary to keep the linearity within $\pm$ 10 per cent. Further adjustment of a few percent can be made with the capacity-wire trimmer located near the crystal board in the final stage of the r-f assembly. (Mesh the tuning capacitor completely to expose this wire.)

f. When the output voltage is correct, adjust the meter calibration of M-101, the r-f monitor meter, for the low frequency range switch setting by adjusting R-152 until the meter reads at the red line. Turn the "RF RANGE" switch to the high frequency setting and adjust R-150 until the needle again is set to the red line.

8-22. AMPLITUDE MODULATION PERCENTAGE TEST. To check the percentage of amplitude modulation of the Type 202-B, interconnect the equipment as shown in figure 8-9, and proceed as follows:

a. Tune the "FREQUENCY MC" dial to 100 mc.

b. Turn "MODULATION METER" switch to "AM" position.

c. Vary the "AM" potentiometer until the modulation meter M-102 reads 50 per cent modulation.

d. Set the "FREQ CPS" switch to the "400" position.

e. A trapezoidal pattern similar to that shown in figure 8-10 will be seen on the oscilloscope. Adjust R-142, the "AM" control on the panel so that the height of the vertical sides of the trapezoid are in a 1:3 proportion, indicating 50 per cent modulation.

f. Adjust R-145, the modulation meter potentiometer so that the meter reads 50 per cent.

g. Check through the low frequency range, adjusting the meter potentiometer where necessary, so that the oscilloscope pattern of 50 per cent modulation agrees with the meter reading of 45 to 55 per cent modulation at all points.

8-23. AMPLITUDE MODULATION DISTORTION TEST. To check AM distortion, interconnect the equipment as shown in figure 8-11, and proceed as follows:

a. Set the modulation for 50 per cent on M-102, the modulation meter.

b. Measure the distortion over the low frequency range of 54-108 mc.

c. If distortion is greater than 6.5 per cent at any point, replace the output tube V-104 and retrack the output stage. (Refer to paragraphs 4-7 and 8-16.)

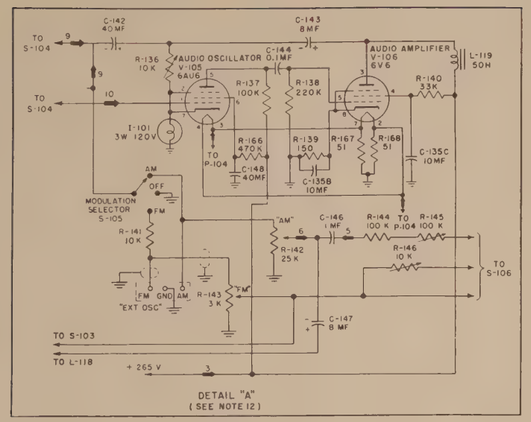
8-24. COMPENSATION FOR SHIELD CAN. Place the shield can A-111 on the r-f assembly and check for its effect upon oscillator calibration, output calibration, output stage alignment, and FM deviation. (Refer to paragraphs 8-13, 8-14, 8-16, and 8-17.) If changes occur, adjust the trimmer screws (H-172 and H-174) in the oscillator and output stages, and the reactance tube (V-101) potentiometer R-105.

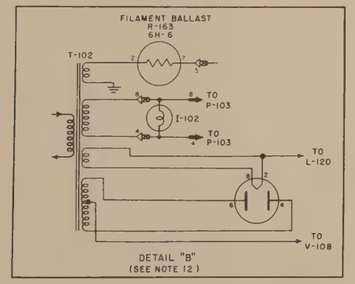
8-25. R-F LEAKAGE TEST. (See figure 8-12.) With the shield can in place, check for leakage around shield base, using a pick-up probe and the AM receiver. Adjust the tightness of the shield until the leakage is less than 2.0 microvolts.

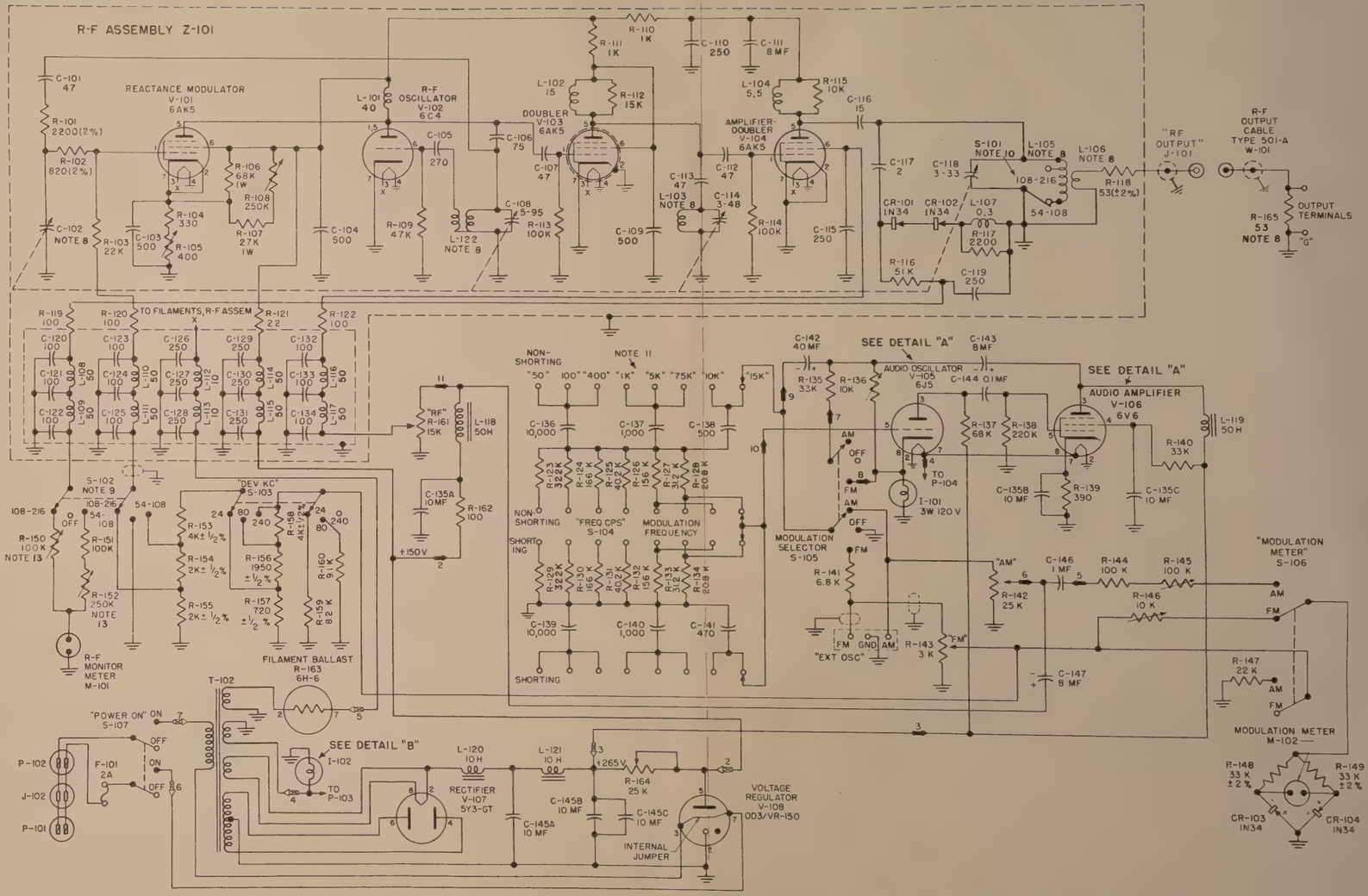
8-26. OVER-ALL R-F ASSEMBLY ADJUSTMENTS. Following the calibration and alignment tests of paragraphs 8-13 through 8-25, perform the adjustments outlined in paragraph 6-18.

SECTION IX

DIAGRAMS



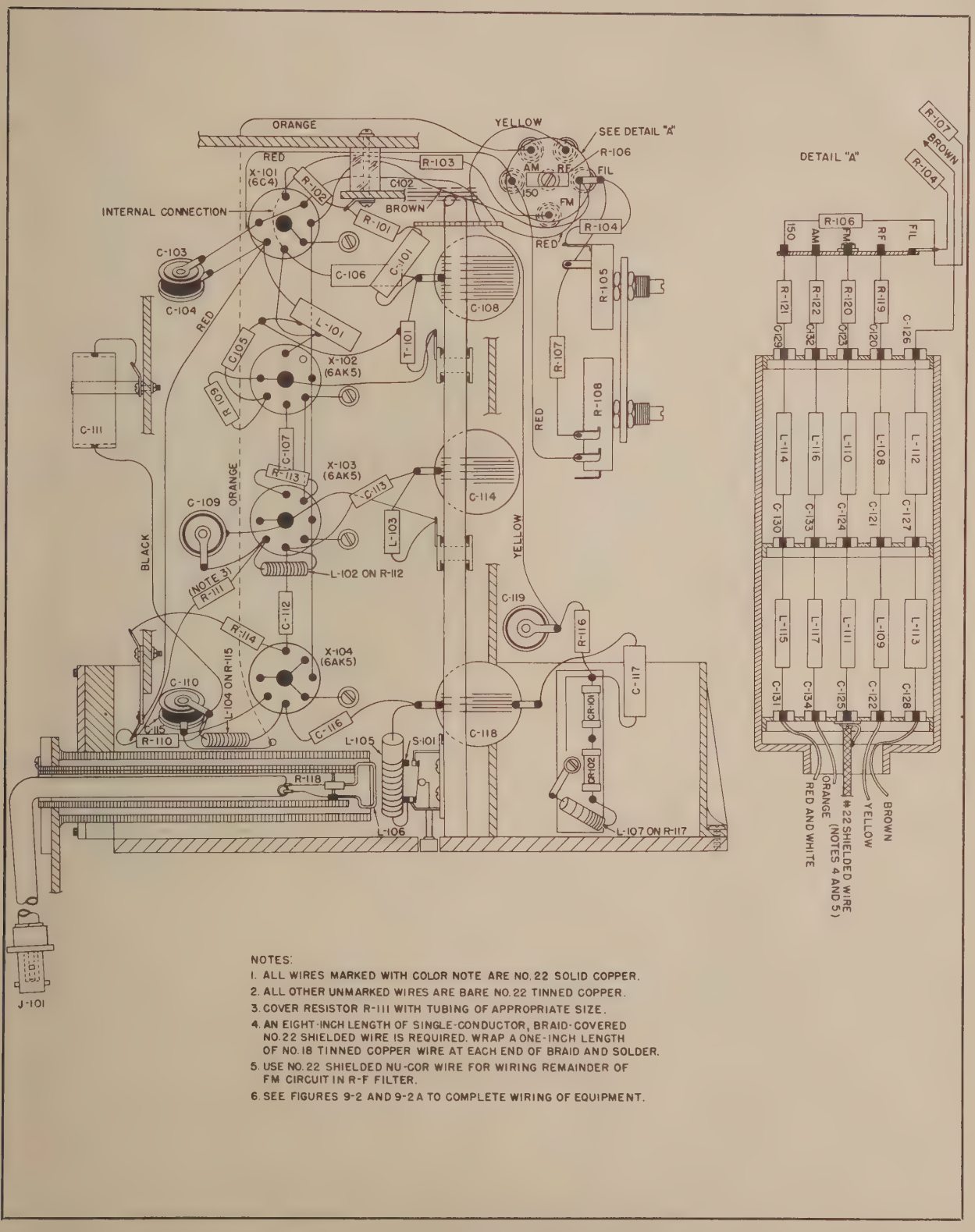




NOTES:

1. ALL RESISTANCE VALUES IN OHMS UNLESS FOLLOWED BY "K"— KILOHM (1,000 OHMS) OR "MEG"— MEGOHM (1,000,000 OHMS).
2. ALL CAPACITANCE VALUES IN MICROMICROFARADS UNLESS FOLLOWED BY "MF"— MICROFARAD.
3. ALL INDUCTANCE VALUES IN MICROHENRIES UNLESS FOLLOWED BY "MH"— MILLIHENRY OR "H"— HENRY.
4. ⟹ REFERS TO CONNECTIONS OF P-103, THE AUDIO OSCILLATOR CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE. REFER TO NOTES 6 AND 7.
5. ⟸ REFERS TO CONNECTIONS OF P-104, THE POWER SUPPLY CABLE CONNECTOR, WITH THE POINT OF THE SYMBOL INDICATING DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE. REFER TO NOTES 6 AND 7.
6. PIN 1 OF P-103 AND P-104 CONNECT TO GROUND.
7. PLUG CONNECTORS P-103 AND P-104 AND MATING CONNECTORS X-110 AND X-111 NOT SHOWN. SEE WIRING DIAGRAMS — FIGURES 9-2, 9-3, 9-3A, and 9-4.
8. THIS PART SPECIALLY SELECTED. REFER TO PARTS CATALOG.
9. GANGED TO SHAFT OF S-101.
10. GANGED TO SHAFT OF S-102.
11. FREQUENCIES IN CPS OF AUDIO OSCILLATOR FOR GIVEN POSITIONS OF S-104.
12. NEW WIRING USED BEGINNING WITH SERIAL NO. 1125.
13. VALUES FOR R-150 AND R-152 CHANGED BEGINNING WITH SERIAL NO. 1125.

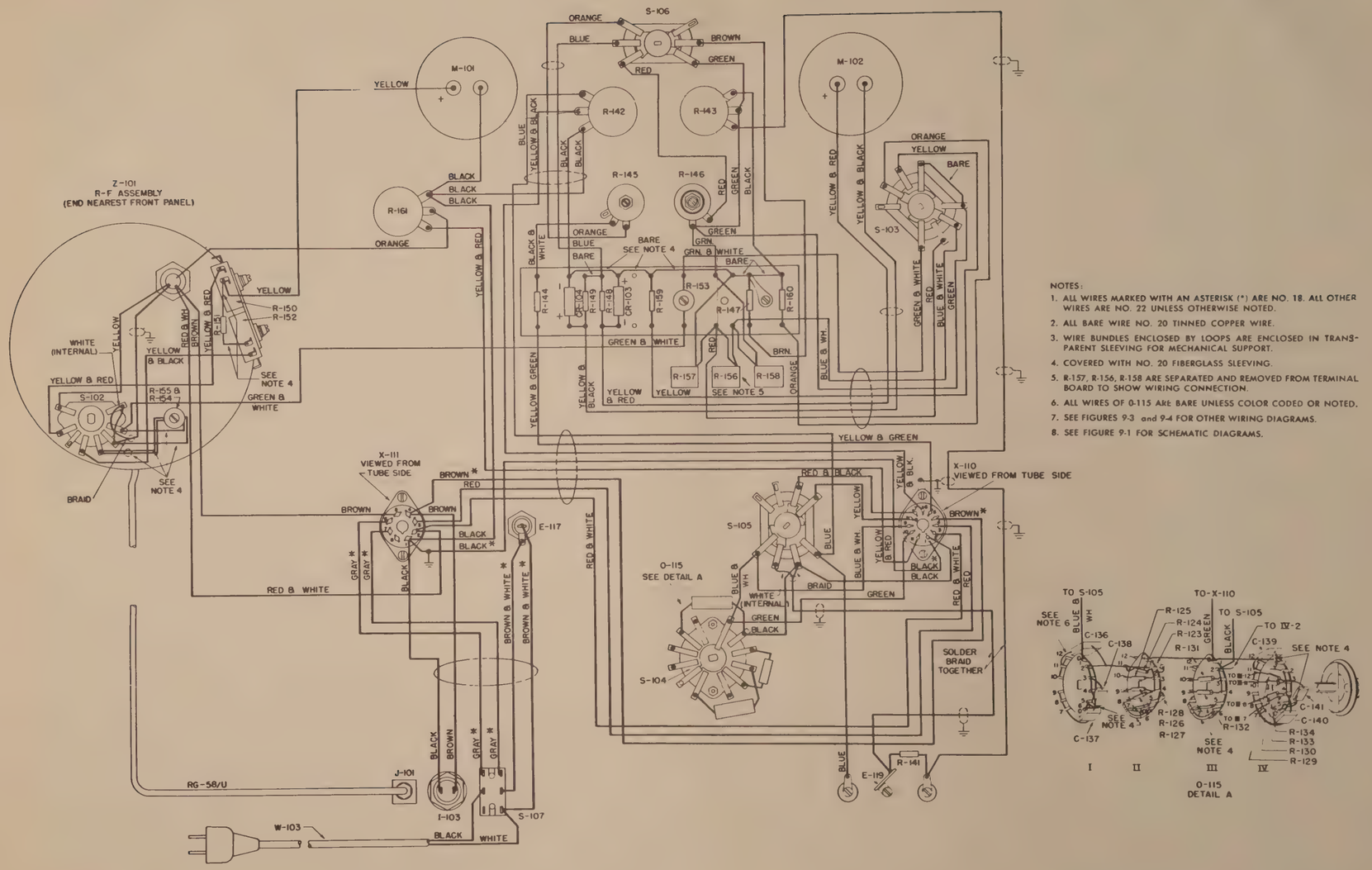
Figure 9-1. FM Signal Generator Type 202-B, Schematic Diagram



NOTES:

1. ALL WIRES MARKED WITH COLOR NOTE ARE NO. 22 SOLID COPPER.
2. ALL OTHER UNMARKED WIRES ARE BARE NO. 22 TINNED COPPER.
3. COVER RESISTOR R-111 WITH TUBING OF APPROPRIATE SIZE.
4. AN EIGHT-INCH LENGTH OF SINGLE-CONDUCTOR, BRAID-COVERED NO. 22 SHIELDED WIRE IS REQUIRED. WRAP A ONE-INCH LENGTH OF NO. 18 TINNED COPPER WIRE AT EACH END OF BRAID AND SOLDER.
5. USE NO. 22 SHIELDED NU-COR WIRE FOR WIRING REMAINDER OF FM CIRCUIT IN R-F FILTER.
6. SEE FIGURES 9-2 AND 9-2A TO COMPLETE WIRING OF EQUIPMENT.

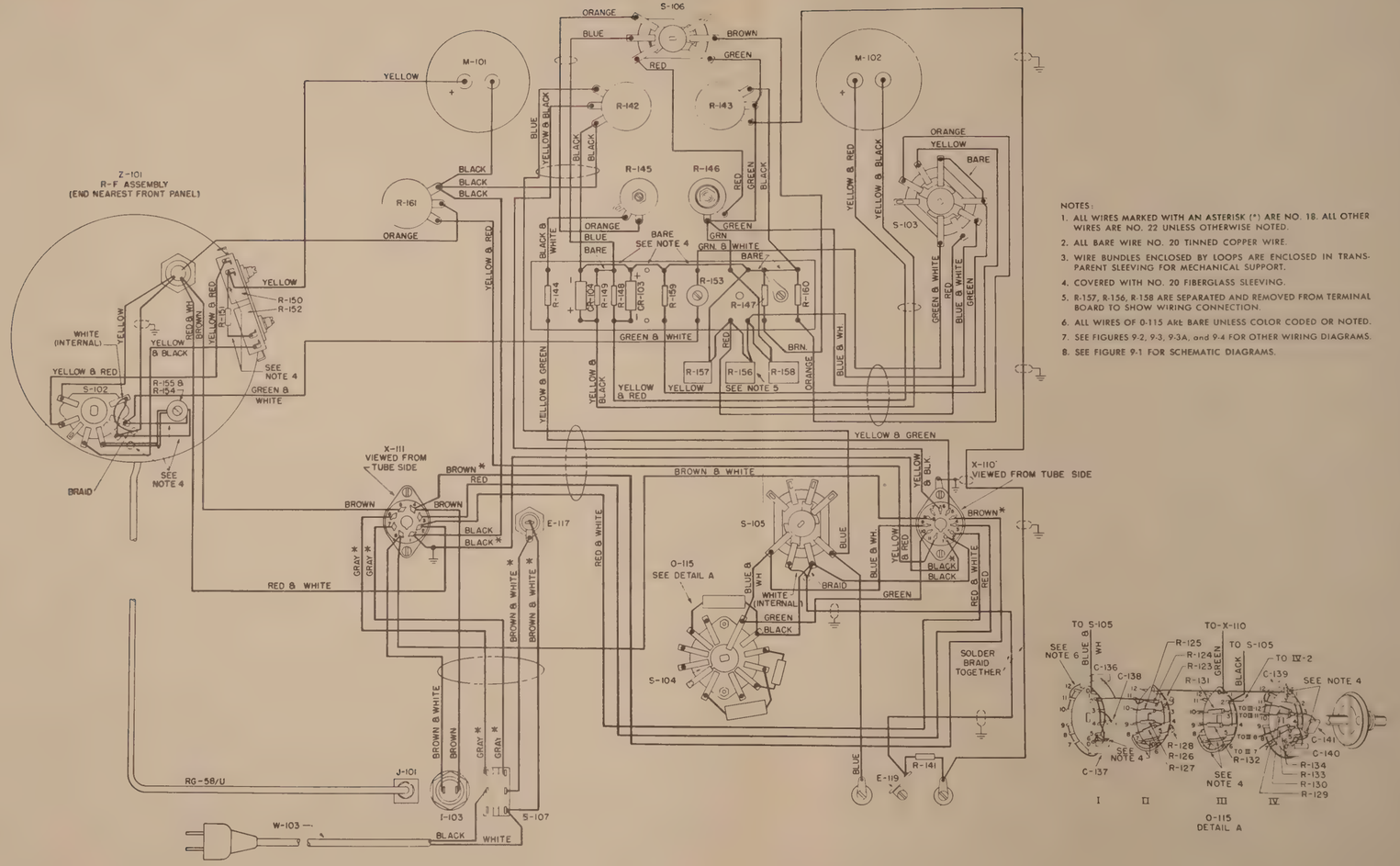
Figure 9-1A. R-F Assembly, Wiring Diagram



NOTES:

1. ALL WIRES MARKED WITH AN ASTERISK (*) ARE NO. 18. ALL OTHER WIRES ARE NO. 22 UNLESS OTHERWISE NOTED.
2. ALL BARE WIRE NO. 20 TINNED COPPER WIRE.
3. WIRE BUNDLES ENCLOSED BY LOOPS ARE ENCLOSED IN TRANSPARENT SLEEVING FOR MECHANICAL SUPPORT.
4. COVERED WITH NO. 20 FIBERGLASS SLEEVING.
5. R-157, R-156, R-158 ARE SEPARATED AND REMOVED FROM TERMINAL BOARD TO SHOW WIRING CONNECTION.
6. ALL WIRES OF 0-115 ARE BARE UNLESS COLOR CODED OR NOTED.
7. SEE FIGURES 9-3 and 9-4 FOR OTHER WIRING DIAGRAMS.
8. SEE FIGURE 9-1 FOR SCHEMATIC DIAGRAMS.

Figure 9-2. Panel Assembly, Wiring Diagram (Serial No. 1-1124)



NOTES:

1. ALL WIRES MARKED WITH AN ASTERISK (*) ARE NO. 18. ALL OTHER WIRES ARE NO. 22 UNLESS OTHERWISE NOTED.
2. ALL BARE WIRE NO. 20 TINNED COPPER WIRE.
3. WIRE BUNDLES ENCLOSED BY LOOPS ARE ENCLOSED IN TRANSPARENT SLEEVING FOR MECHANICAL SUPPORT.
4. COVERED WITH NO. 20 FIBERGLASS SLEEVING.
5. R-157, R-156, R-158 ARE SEPARATED AND REMOVED FROM TERMINAL BOARD TO SHOW WIRING CONNECTION.
6. ALL WIRES OF 0-115 ARE BARE UNLESS COLOR CODED OR NOTED.
7. SEE FIGURES 9-2, 9-3, 9-3A, and 9-4 FOR OTHER WIRING DIAGRAMS.
8. SEE FIGURE 9-1 FOR SCHEMATIC DIAGRAMS.

Figure 9-2A. Panel Assembly, Wiring Diagram (Serial No. 1125 and following)

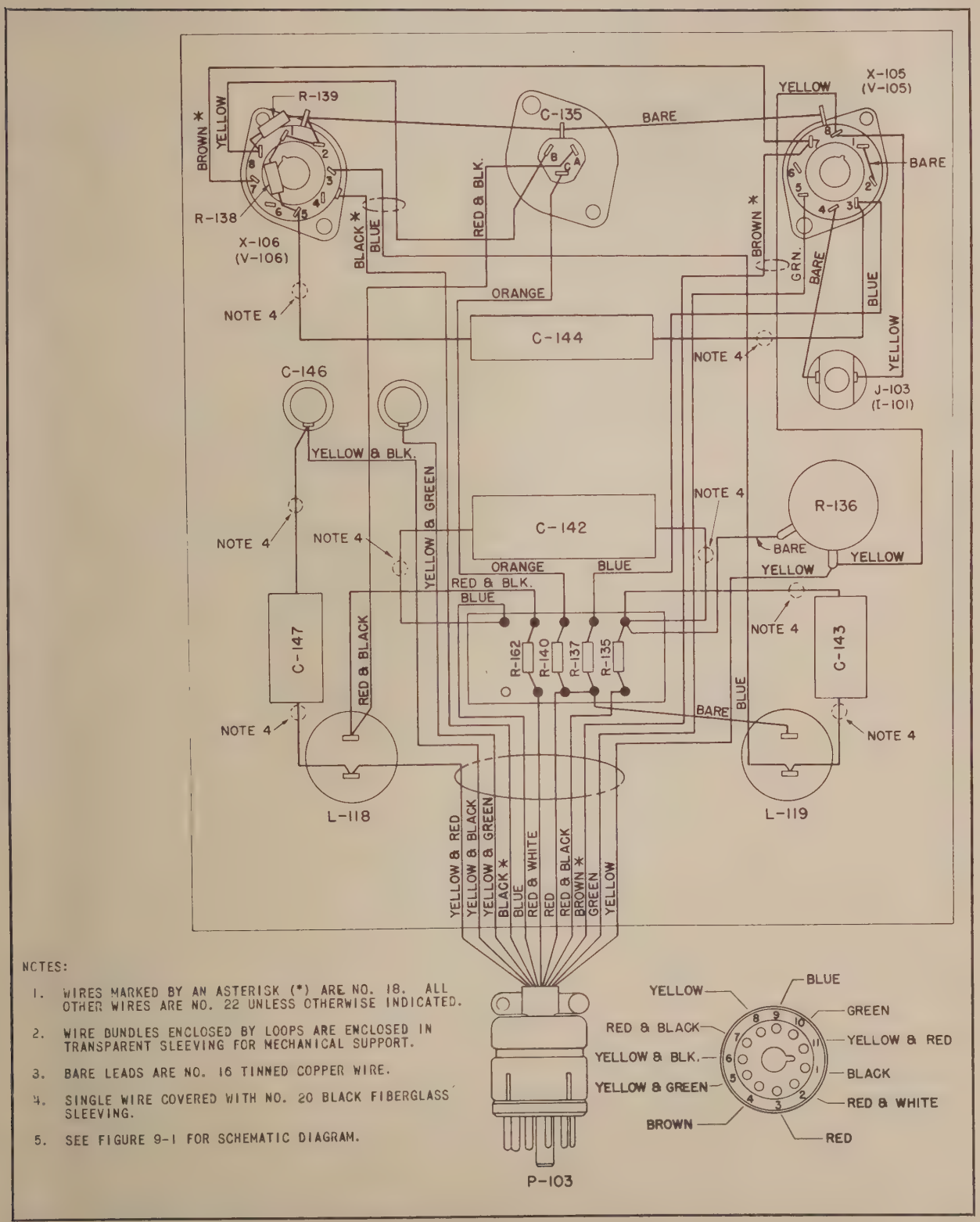
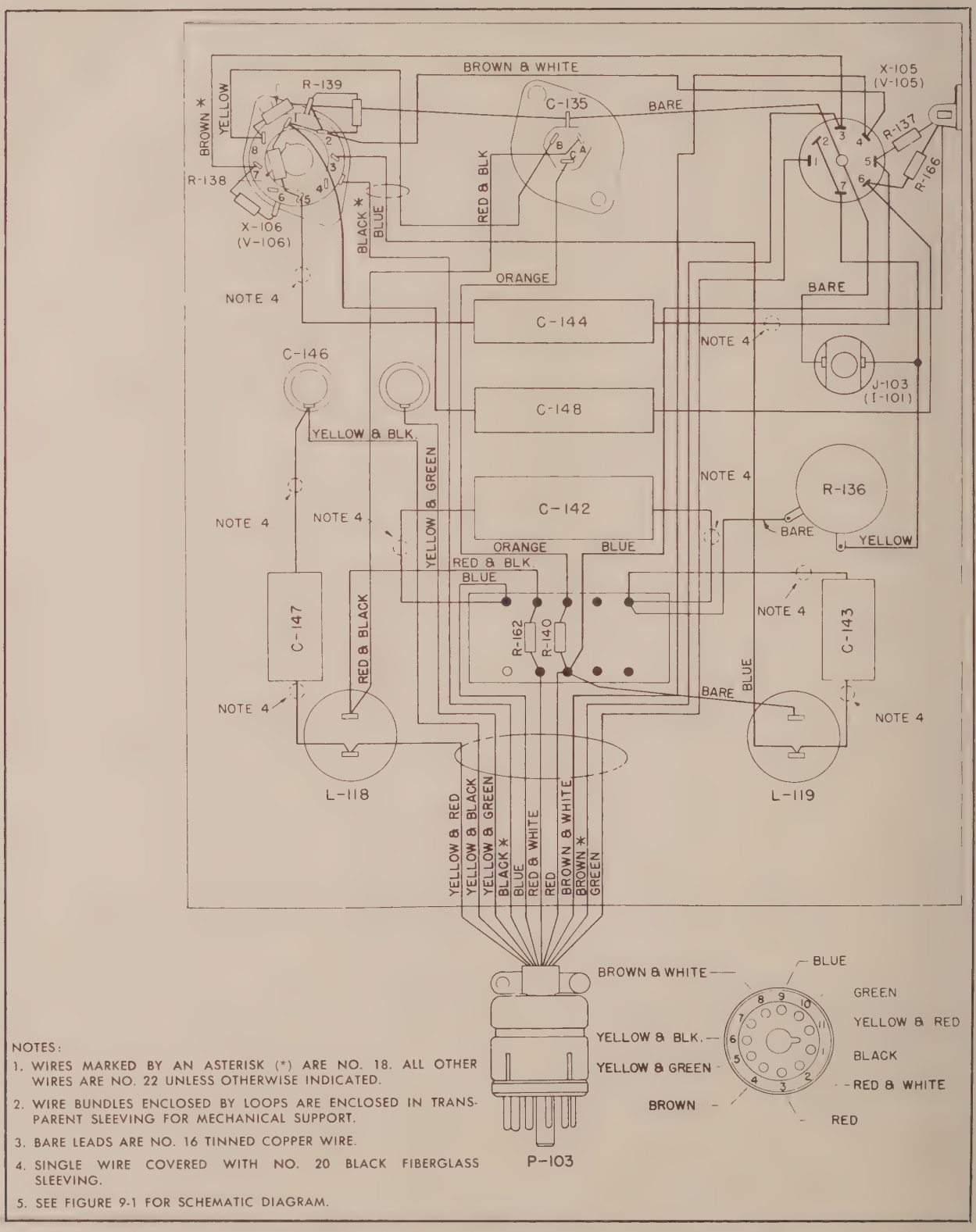


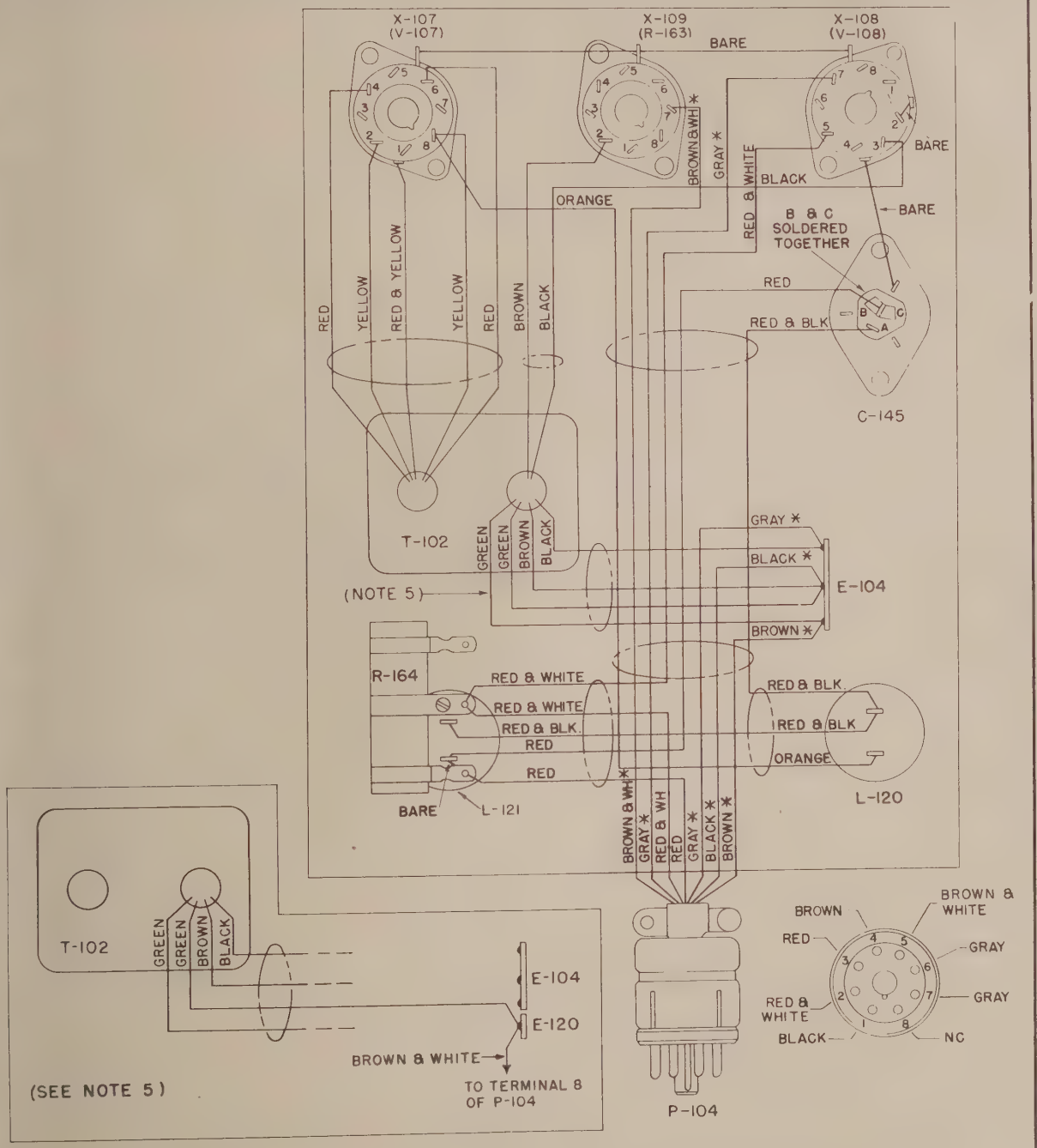
Figure 9-3. Audio Oscillator Assembly, Wiring Diagram (Serial No. 1-1124)



NOTES:

1. WIRES MARKED BY AN ASTERISK (*) ARE NO. 18. ALL OTHER WIRES ARE NO. 22 UNLESS OTHERWISE INDICATED.
2. WIRE BUNDLES ENCLOSED BY LOOPS ARE ENCLOSED IN TRANSPARENT SLEEVING FOR MECHANICAL SUPPORT.
3. BARE LEADS ARE NO. 16 TINNED COPPER WIRE.
4. SINGLE WIRE COVERED WITH NO. 20 BLACK FIBERGLASS SLEEVING.
5. SEE FIGURE 9-1 FOR SCHEMATIC DIAGRAM.

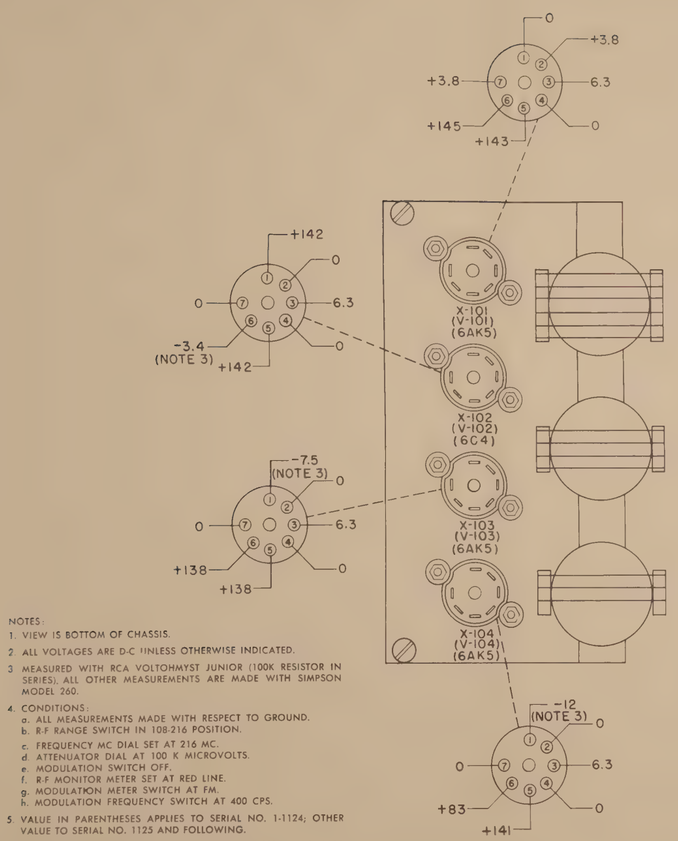
Figure 9-3A. Audio Oscillator Assembly, Wiring Diagram (Serial No. 1125 and Following)



NOTES:

1. WIRES (EXCEPT TRANSFORMER LEADS) MARKED BY AN ASTERISK (*) ARE NO. 18. ALL OTHER WIRES ARE NO. 22 UNLESS OTHERWISE INDICATED.
2. WIRE BUNDLES ENCLOSED BY LOOPS ARE ENCLOSED IN TRANSPARENT TUBING FOR MECHANICAL SUPPORT.
3. BARE LEADS ARE NO. 16 TINNED COPPER WIRE.
4. SEE FIGURE 9-1 FOR SCHEMATIC DIAGRAM OF COMPLETE UNIT.
5. FILAMENT WIRING REVISED BEGINNING WITH SERIAL NO. 1125. SEE INSET.

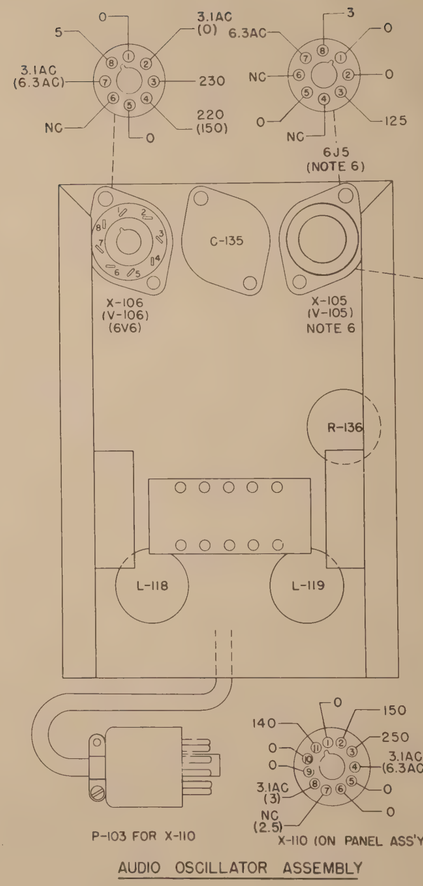
Figure 9-4. Power Supply, Wiring Diagram



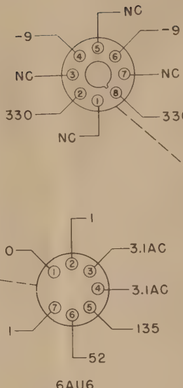
NOTES:

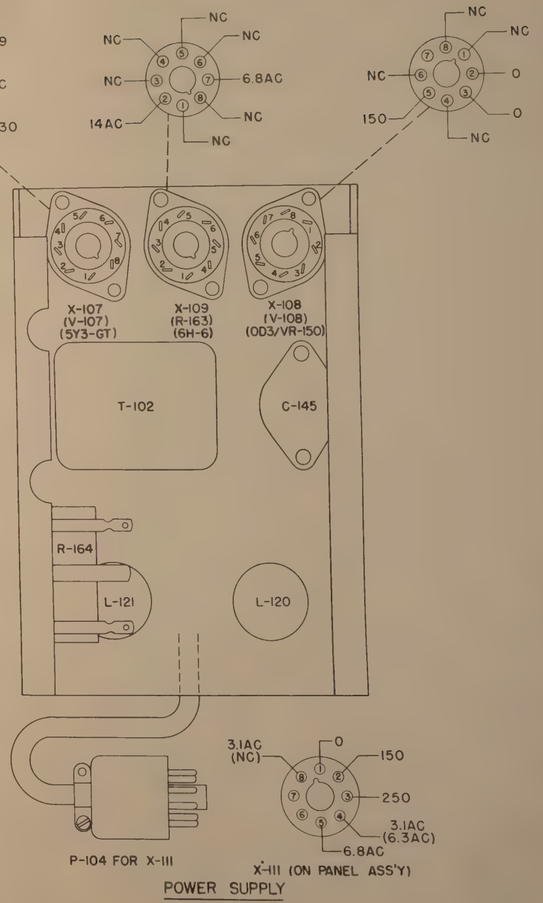
1. VIEW IS BOTTOM OF CHASSIS.
2. ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.
3. MEASURED WITH RCA VOLTOHMYST JUNIOR (100K RESISTOR IN SERIES). ALL OTHER MEASUREMENTS ARE MADE WITH SIMPSON MODEL 260.
4. CONDITIONS:
   a. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
   b. R-F RANGE SWITCH IN 108-216 POSITION.
   c. FREQUENCY MC DIAL SET AT 216 MC.
   d. ATTENUATOR DIAL AT 100 K MICROVOLTS.
   e. MODULATION SWITCH OFF.
   f. R-F MONITOR METER SET AT RED LINE.
   g. MODULATION METER SWITCH AT FM.
   h. MODULATION FREQUENCY SWITCH AT 400 CPS.
5. VALUE IN PARENTHESES APPLIES TO SERIAL NO. 1-1124; OTHER VALUE TO SERIAL NO. 1125 AND FOLLOWING.
6. TYPE 6J5 USED IN SERIAL NO. 1-1124; 6AU6 IN SERIAL NO. 1125 AND FOLLOWING

R F ASSEMBLY



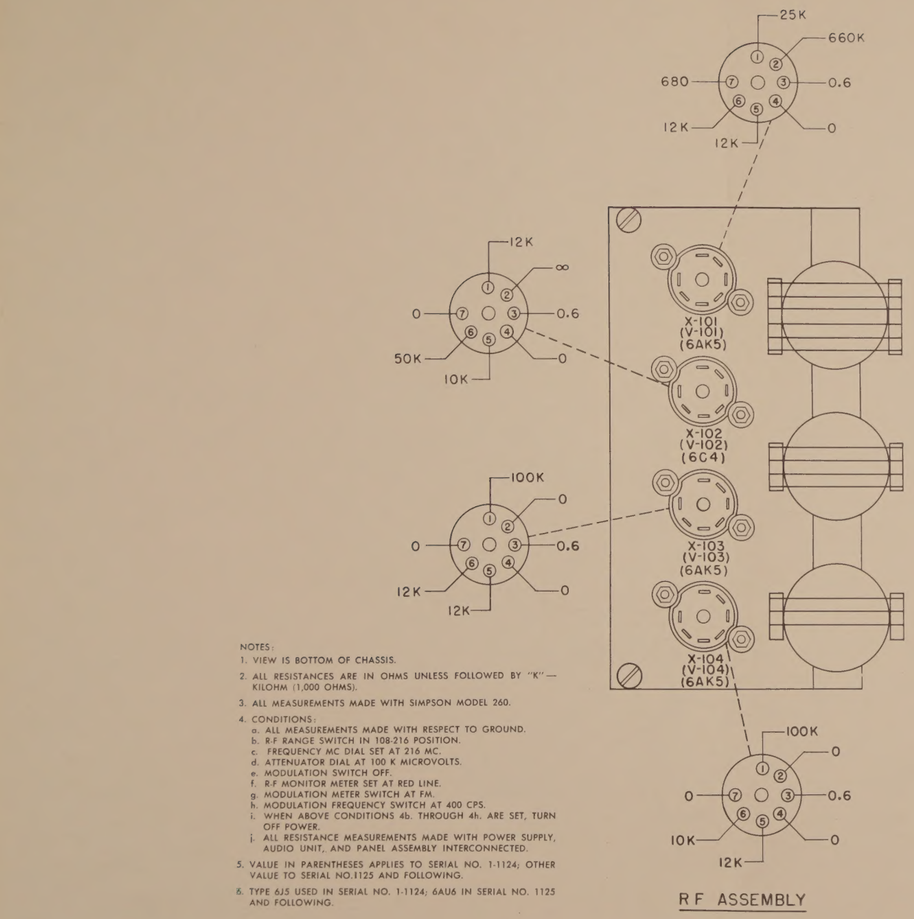
AUDIO OSCILLATOR ASSEMBLY





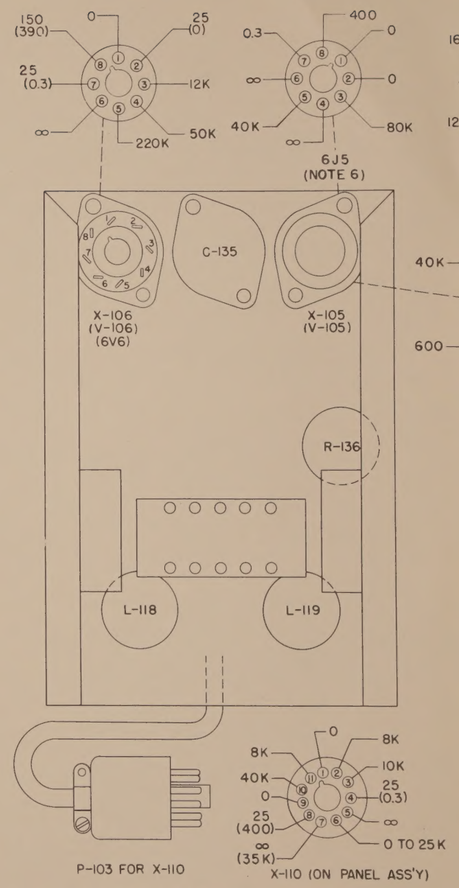
POWER SUPPLY

Figure 9-5. FM Signal Generator Type 202-B, Terminal Voltage Diagram



NOTES:

1. VIEW IS BOTTOM OF CHASSIS.
2. ALL RESISTANCES ARE IN OHMS UNLESS FOLLOWED BY "K" — KILOHM (1,000 OHMS).
3. ALL MEASUREMENTS MADE WITH SIMPSON MODEL 260.
4. CONDITIONS:
   a. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
   b. R-F RANGE SWITCH IN 108-216 POSITION.
   c. FREQUENCY MC DIAL SET AT 216 MC.
   d. ATTENUATOR DIAL AT 100 K MICROVOLTS.
   e. MODULATION SWITCH OFF.
   f. R-F MONITOR METER SET AT RED LINE.
   g. MODULATION METER SWITCH AT FM.
   h. MODULATION FREQUENCY SWITCH AT 400 CPS.
   i. WHEN ABOVE CONDITIONS 4b. THROUGH 4h. ARE SET, TURN OFF POWER.
   j. ALL RESISTANCE MEASUREMENTS MADE WITH POWER SUPPLY, AUDIO UNIT, AND PANEL ASSEMBLY INTERCONNECTED.
5. VALUE IN PARENTHESES APPLIES TO SERIAL NO. 1-1124; OTHER VALUE TO SERIAL NO.1125 AND FOLLOWING.
6. TYPE 6J5 USED IN SERIAL NO. 1-1124; 6AU6 IN SERIAL NO. 1125 AND FOLLOWING.



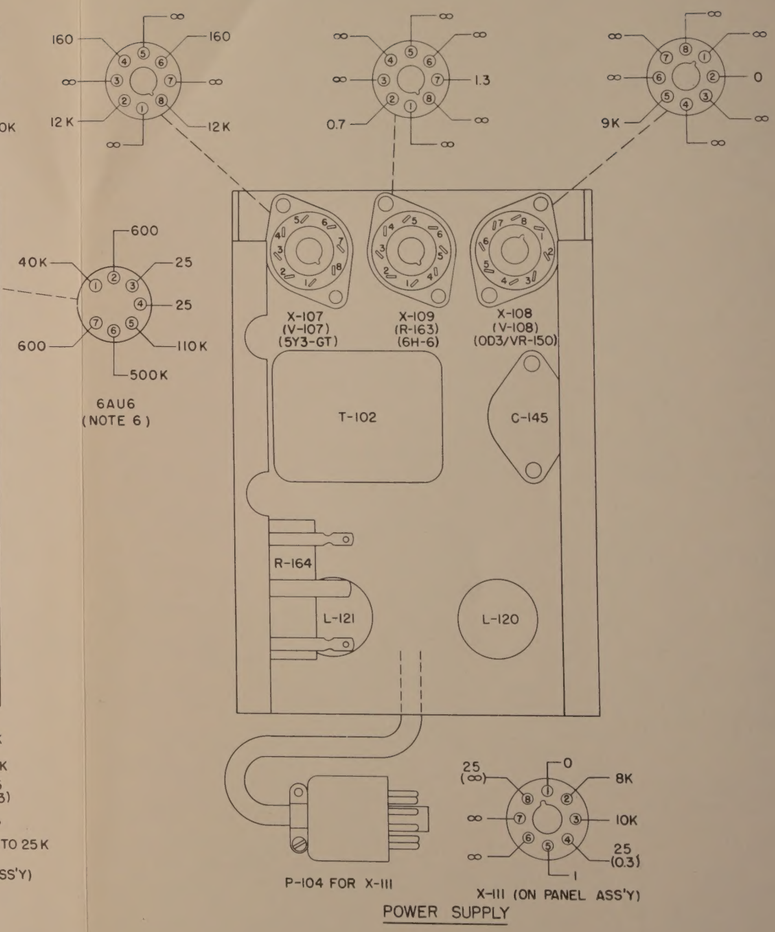


Figure 9-6. FM Signal Generator Type 202-B, Terminal Resistance Diagram